

8/a 5573
2.63
2 QE
74
K5X
V.4
NH



PROFESSIONAL PAPERS OF THE ENGINEER DEPARTMENT, U. S. ARMY.

No. 18.

REPORT
OF THE
GEOLOGICAL EXPLORATION OF THE FORTIETH PARALLEL,
MADE

BY ORDER OF THE SECRETARY OF WAR ACCORDING TO ACTS OF
CONGRESS OF MARCH 2, 1867, AND MARCH 3, 1869,

UNDER THE DIRECTION OF

BRIG. AND BVT. MAJOR GENERAL A. A. HUMPHREYS,
CHIEF OF ENGINEERS

BY
✓
CLARENCE KING,
U. S. GEOLOGIST.



VOLUME IV.

5573
206 763
UNITED STATES GEOLOGICAL EXPLORATION OF THE FORTIETH PARALLEL.

CLARENCE KING, GEOLOGIST-IN-CHARGE.

PART I.
PALÆONTOLOGY.

BY

F. B. MEEK.

PART II.
PALÆONTOLOGY.

BY

JAMES HALL AND R. P. WHITFIELD.

PART III.
ORNITHOLOGY.

BY

ROBERT RIDGWAY.

SUBMITTED TO THE CHIEF OF ENGINEERS AND PUBLISHED BY ORDER OF THE SECRETARY OF
WAR UNDER AUTHORITY OF CONGRESS.

ILLUSTRATED BY XXIV PLATES.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1877.

V-VI

TABLE OF CONTENTS.

	Page.
INTRODUCTORY LETTER	XI
PART I. PALÆONTOLOGY, BY F. B. MEEK	1
INTRODUCTORY REMARKS	3
DESCRIPTIONS OF FOSSILS—SILURIAN SPECIES	17
DEVONIAN SPECIES	25
CARBONIFEROUS SPECIES	50
TRIASSIC SPECIES	99
JURASSIC SPECIES	130
CRETACEOUS SPECIES	140
FRESH AND BRACKISH-WATER SPECIES	163
TERTIARY SPECIES	182
PART II. PALÆONTOLOGY, BY JAMES HALL AND R. P. WHITFIELD	198
GENERAL REMARKS	199
FOSSILS OF THE POTSDAM	205
LOWER SILURIAN	232
DEVONIAN	246
WAVERLY	251
LOWER CARBONIFEROUS	265
COAL-MEASURES AND PERMO-CARBONIFEROUS	273
TRIASSIC	280
JURASSIC	284
PART III. ORNITHOLOGY, BY ROBERT RIDGWAY	303
TABLE OF CONTENTS	305
LETTER OF TRANSMISSION	307
DESCRIPTION OF THE ROUTE	309
PHYSICAL FEATURES OF THE GREAT BASIN	313
LOCAL AVIFAUNÆ	316
DESCRIPTION OF CAMPS	328
GENERAL REMARKS ON THE BASIN AVIFAUNÆ	377
CATALOGUE OF SPECIES	386
BIOGRAPHICAL SECTION	391
INDEX TO PART I	645
INDEX TO PART II	649
INDEX TO PART III	652

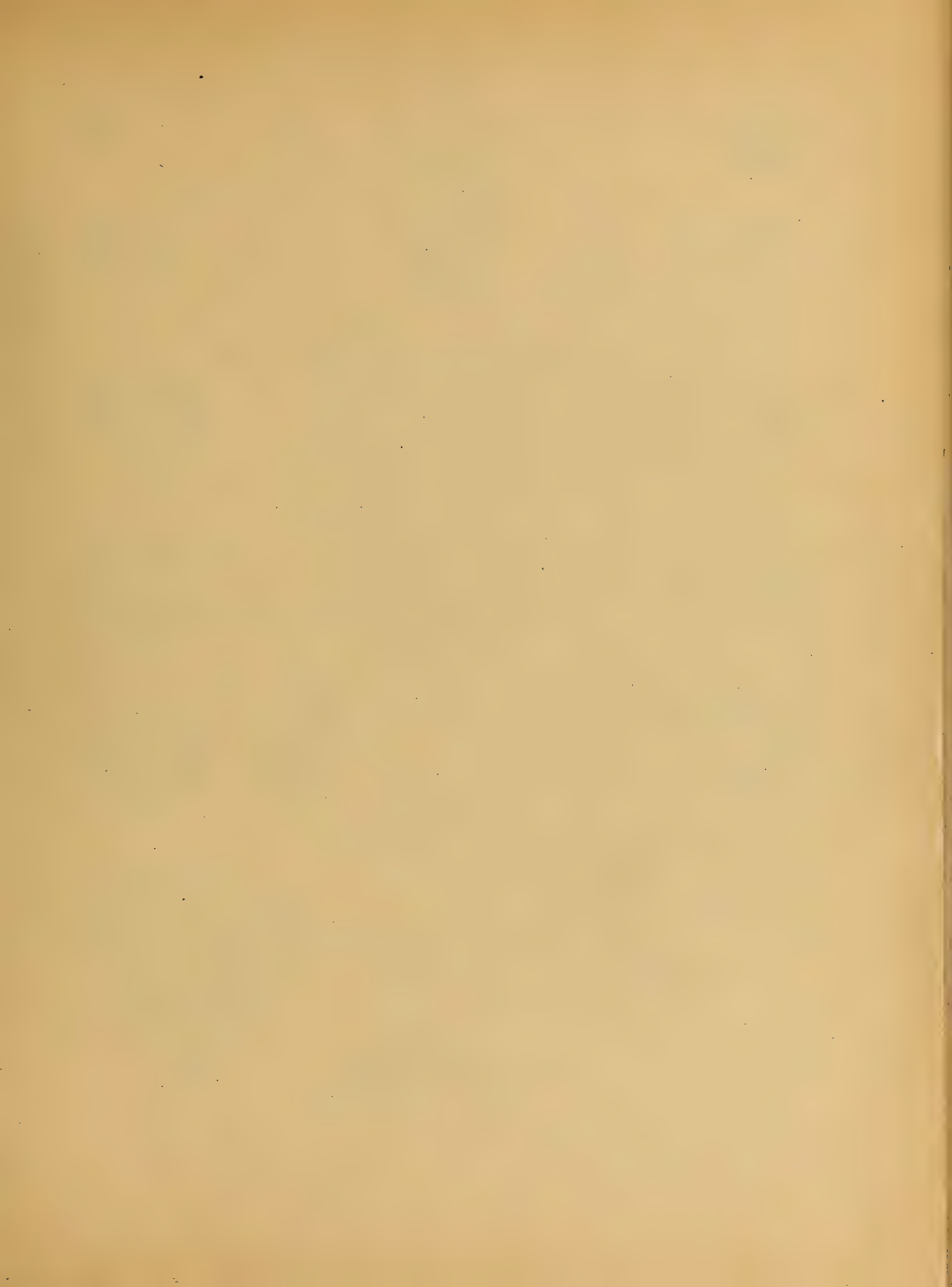


PLATE I.

	Page.
Fig. 1. <i>OPHILETA COMPLANATA</i> , var. <i>NANA</i>	17
1. An upper view of a specimen, natural size, as seen lying in the matrix.	
1 a. The same, enlarged.	
1 b. Profile view, enlarged.	
Fig. 2. <i>RAPHISTOMA</i> ? <i>ROTULIFORMIS</i>	18
2. View of upper side, natural size.	
2 a. Profile view of same.	
2 b. Under side of same, magnified. [In the specimen, the umbilicus is filled with rock, though its subangular margins are exposed.]	
Fig. 3. <i>RAPHISTOMA</i> ? <i>TROCHISCUS</i>	19
3. Upper side, natural size.	
3 a. Profile.	
3 b. Under side, enlarged. [The umbilicus is filled with rock in the specimen, but its margin is clearly seen.]	
Fig. 4. <i>CONOCORYPHE KINGII</i> . Upper view, natural size	20
[The specimen is accidentally compressed so as to spread out the posterior extremities of the cephalic shield more than is natural. Broken edges of the crust are also in the figure wrongly made to look like small nodes at the ends of the segments of the mesial lobe.]	
Fig. 5. <i>PARADOXIDES</i> ? <i>NEVADENSIS</i> . Shows upper side of a part of thorax and pygidium	23
Fig. 6. <i>FAVOSITES</i> (undt. sp.)	27
Fig. 7. <i>ATRYPA RETICULARIS</i>	38
7. Dorsal view.	
7 a. Side view.	
Fig. 8. <i>EDMONDIA</i> ? <i>PINONENSIS</i>	46
8. Side view of a large specimen, natural size.	
8 a. Opposite view of a smaller specimen.	
Fig. 9. <i>SPIRIFER PINONENSIS</i>	45
9. Dorsal view, natural size.	
9 a. Profile view of same.	
9 b. Ventral view of same.	
Fig. 10. <i>PRÆTUS DENTICULATUS</i>	49
10. The glabella embedded in the matrix (enlarged two diameters).	
10 a. Pygidium, enlarged two diameters.	
10 b. One of the thoracic segments seen in profile (enlarged two diameters).	
Fig. 11. <i>DALMANITES</i> (undt. sp.)	48
11. A mould of the pygidium.	
11 a. Another specimen of same.	

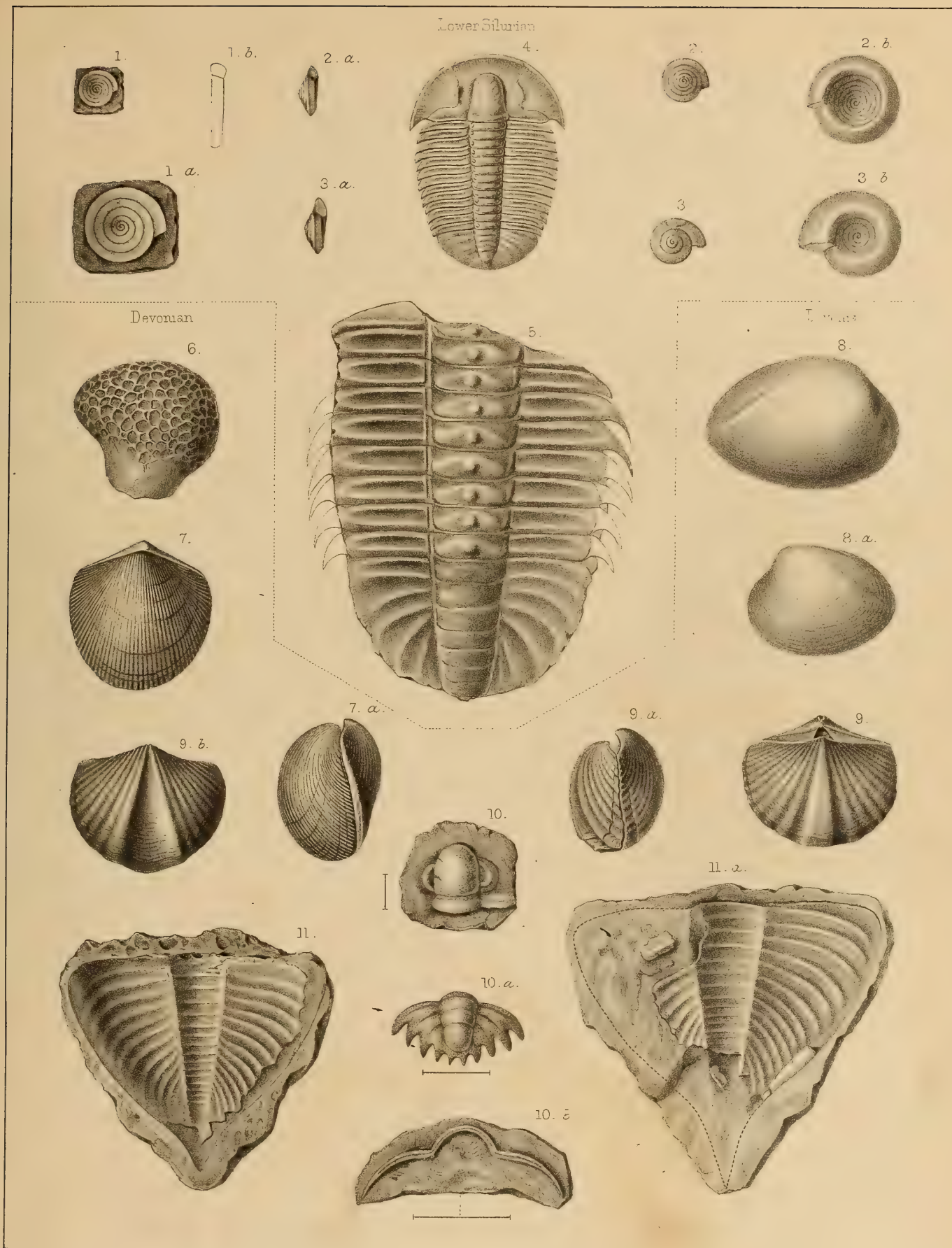


PLATE II.

	Page.
Fig. 1. PTYCHOPHYLLUM INFUNDIBULUM	23
1. A longitudinal section, showing the depth of the calice, with the unfundibuliform plates, and appearances of a columella.	
1 a. An upper view of another specimen.	
1 b. A side view of a third specimen.	
Fig. 2. CYATHOPHYLLUM PALMERI	33
View of upper side, showing the young corallites at places growing in the middle of the calices of the old.	
Fig. 3. FAVOSITES POLYMORPHA ??	27
Fig. 4. DIPHYPHYLLUM FASCICULUM	29
4. A side view of a bundle of the corallites, imperfect at both ends, and showing them to coalesce at intervals.	
4 a. A longitudinal section of one of same, enlarged, showing the wide inner area occupied by broad, slightly arching tabulæ (without any traces of a columella), and the very narrow, outer vesicular area.	
4 b. A transverse section of same, enlarged.	
Fig. 5. ACERVULARIA PENTAGONA	31
5. View of upper side, showing corallites, natural size.	
5 a. A transverse section of a few of the corallites, enlarged.	
Fig. 6. SMITHIA HENNAHII	32
6. View of surface, showing corallites, natural size.	
6 a. Transverse section of same, enlarged.	
Fig. 7. ALVEOLITES MULTILAMELLA	25
7. View of a flat, vertical, weathered section.	
7 a. A portion of same, polished and magnified, so as to show the numerous, thin, crowded tabulæ, and the mural pores; the latter being seen through the transparent calcareous matter filling the interior.	
7 b. A transverse section of the same, showing the forms of the corallites, magnified.	
Fig. 8. ORTHOCERAS KINGII	47
Fig. 9. ORTHOCERAS (undt. sp.)	48

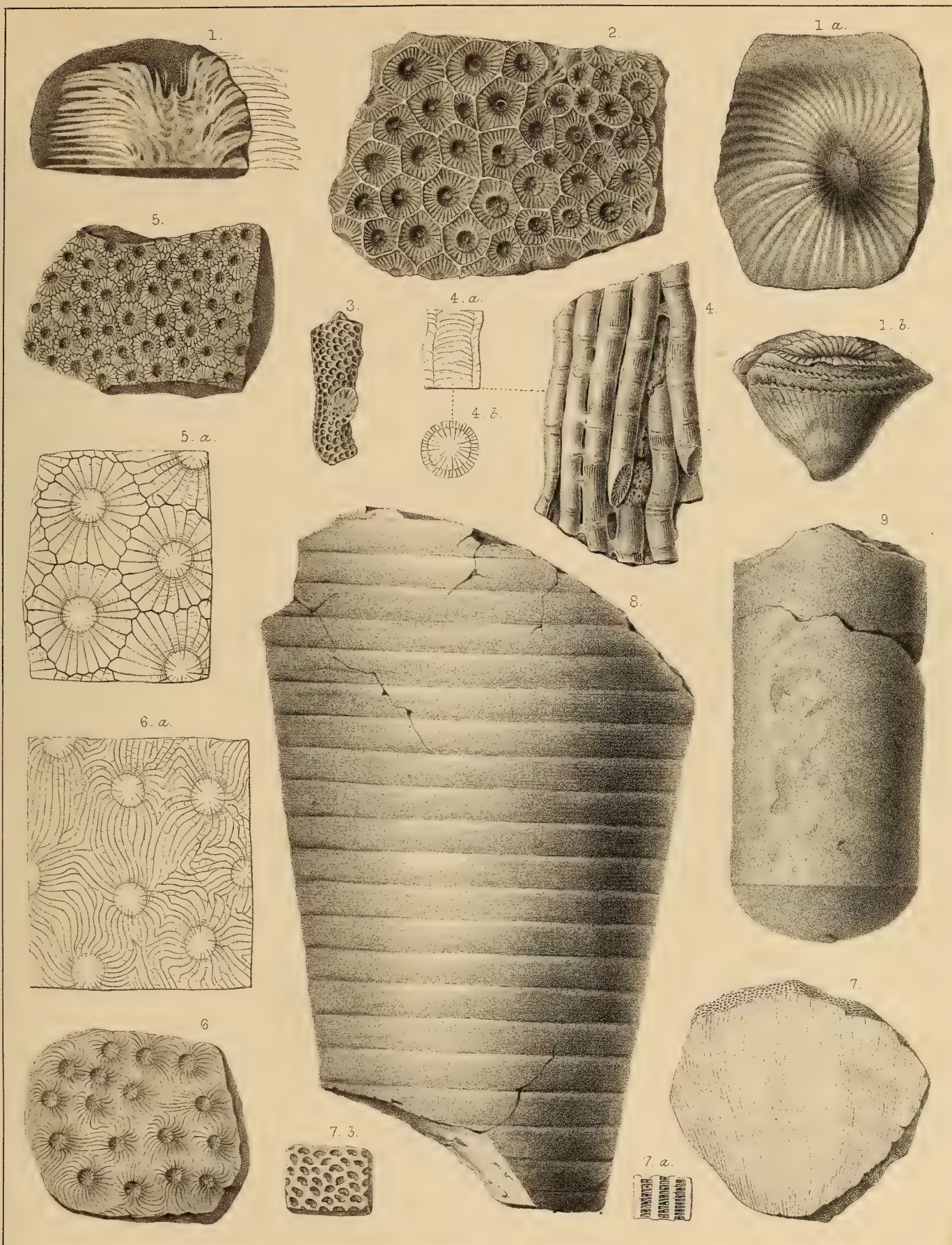


PLATE III.

Fig. 1. SPIRIFER UTAHENSIS.....	Page. 39
1. An antero-ventral view, natural size.	
1 a. Dorsal view of same specimen.	
1 b. A side view of a smaller specimen.	
1 c. A cardinal view of another specimen, showing area and foramen.	
1 d. Cardinal view of the ventral valve of the largest specimen seen.	
1 e. An antero-ventral view of same.	
Fig. 2. HEMIPRONITES CHEMUNGENSIS, <i>var.</i> ARCTOSTRIATA.....	35
2. View of ventral valve, with an oblique view of area.	
Fig. 3. SPIRIFER ENGELMANNI.....	41
3. A cardinal view, showing area and foramen.	
3 a. A side view of same.	
3 b. Dorsal view of same.	
3 c. An antero-ventral view.	
3 d. A ventral view of another specimen apparently of this species.	
3 e. Dorsal view of last.	
Fig. 4. SPIRIFER ARGENTARIUS.....	42
4. A ventral view.	
4 a. Cardinal view of same specimen, showing its low, strongly incurved area, foramen, etc.	
4 b. A dorsal view of same.	
Fig. 5. SPIRIFER STRIGOSUS.....	43
5. View of ventral valve.	
5 a. View of dorsal valve.	
5 b. Profile view of same.	
Fig. 6. ATRYPA RETICULARIS.....	38
6. Ventral view.	
6 a. Dorsal view of another specimen with finer striae.	
Fig. 7. PRODUCTUS SUBACULEATUS ?.....	36
7. Ventral view.	
7 a. Ventral view of another more elongated specimen.	
7 b. A cast of the exterior of a dorsal valve of same.	
Fig. 8. POSIDONOMYA ? FRAGOSA.....	92
8. A left valve, flattened by pressure between the laminæ of shale, with the edges about the beak incomplete.	
8 a. A smaller right valve flattened in the same way, and showing indications of a small anterior ear-like projection.	
Fig. 9. LEIORHYNCHUS ? QUADRICOSTATUS.....	79
9. An internal cast of a ventral valve, flattened by pressure.	
9 a-b. Internal casts of two dorsal valves, somewhat compressed.	
Fig. 10. AVICULOPECTEN CATACTUS.....	93
10. A left valve, somewhat enlarged.	
10 a. Another left valve, natural size.	
10 b. A right valve, apparently of this species, enlarged about two diameters; much of its pallial margin being broken away.	
Fig. 11. SPIRIFER (SYRINGOTHYRIS) CUSPIDATUS.....	87
11. A cardinal view, showing the high area and foramen, and, within the latter, the transverse septum and internal tube.	
11 a. An anterior view of same.	

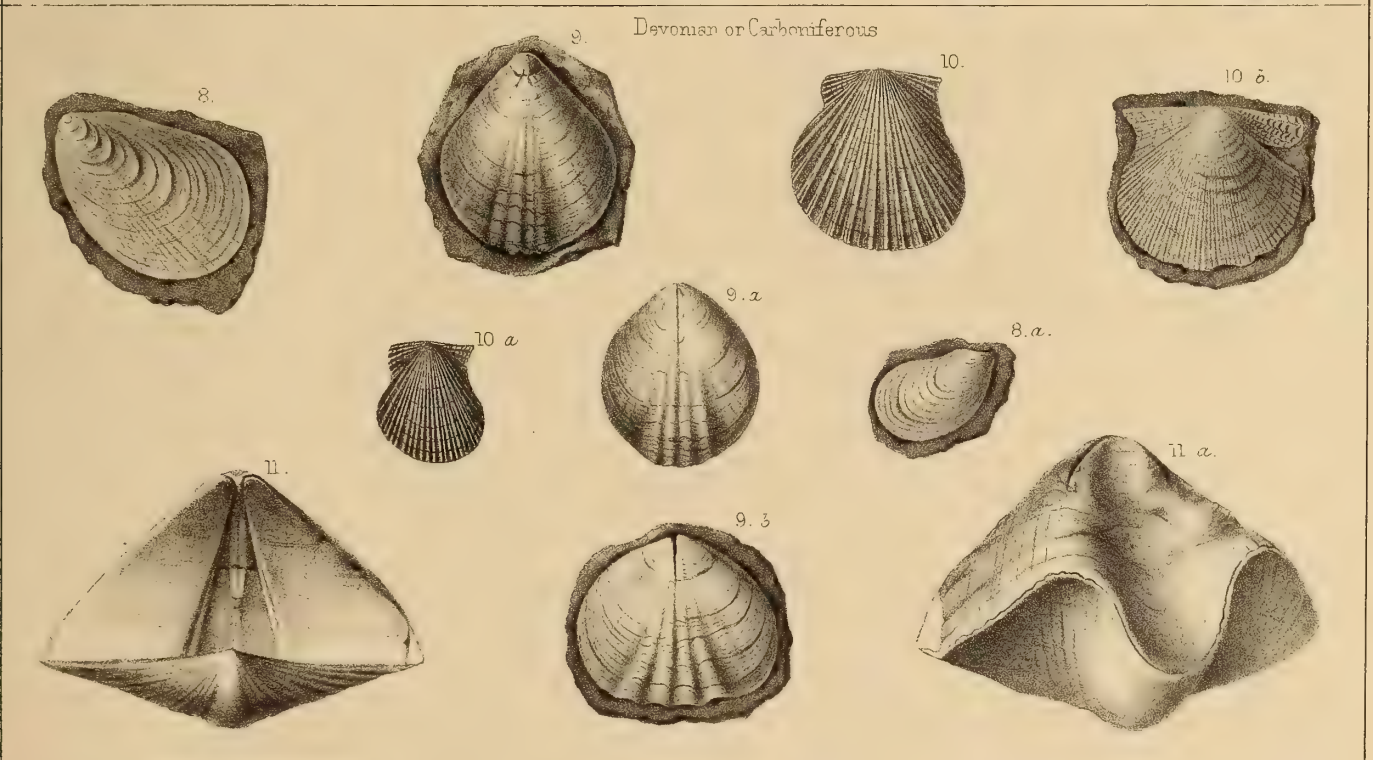
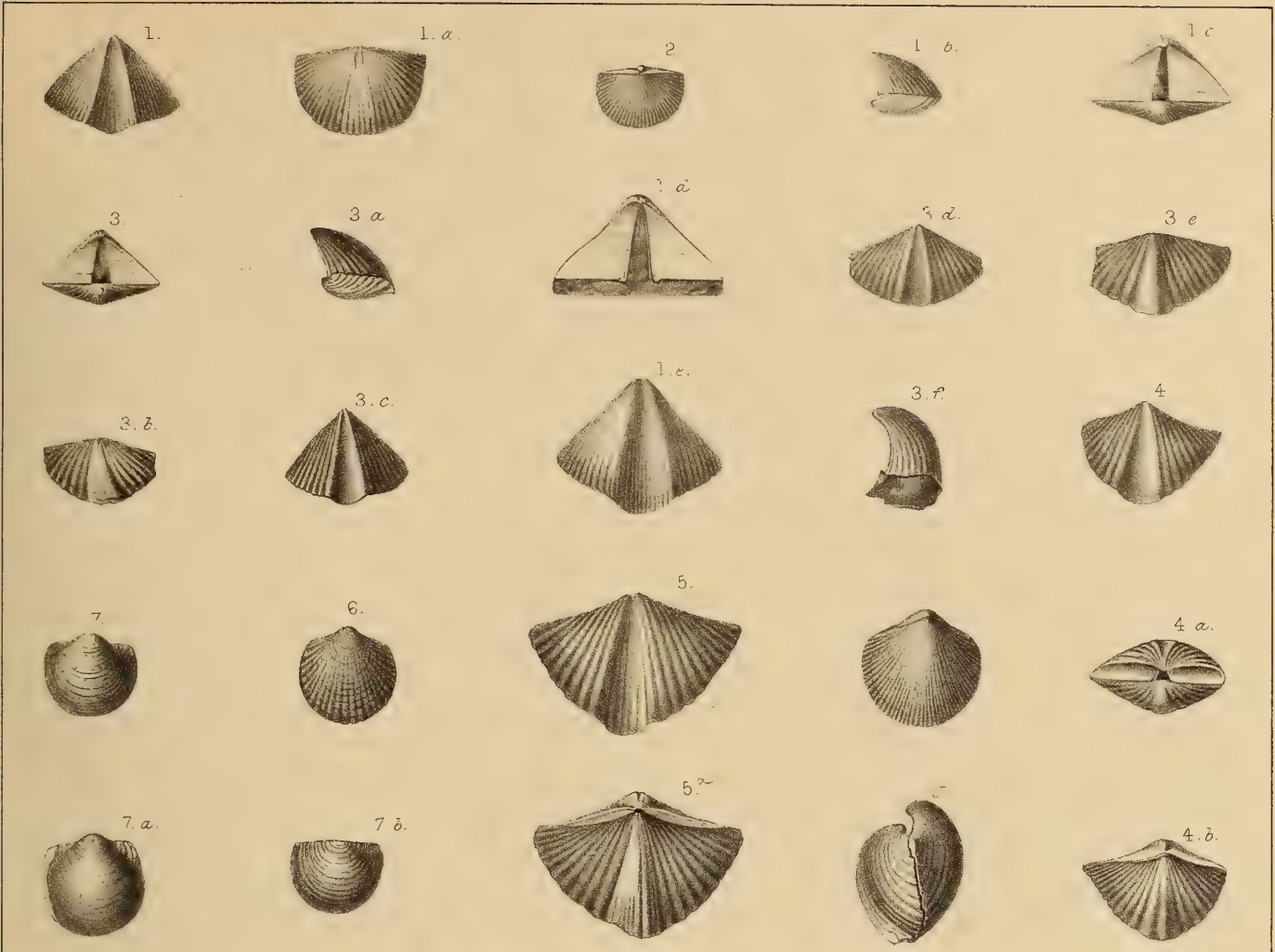


PLATE IV.

- | | |
|---|---------------------|
| <p>Fig. 1. ZAPHRENTIS EXCENTRICA</p> <p>1. An oblique upper view, showing the excentric calice, with its margins broken away.</p> <p>1 a. A longitudinal section of same, mainly as exposed by fracture, showing the very broad tabulæ (<i>t</i>); and at (<i>v</i>) the large vesicular space on the ventral side. The points marked (<i>s, s, s</i>) show the lateral surfaces of the septa, which are marked with curved striæ; while the points (<i>g, g, g, g</i>) show the surfaces of the septa ground smooth; (<i>t</i>) is the fossula.</p> <p>1 b. A dorsal view of the coral as seen with the epitheca worn or weathered off, so as to show the edges of the septa divaricating along the middle of the dorsal side.</p> <p>1 c. A side view of same specimen.</p> <p>1 d. A transverse section of same, nearly at the middle.</p> | <p>Page.
52</p> |
|---|---------------------|

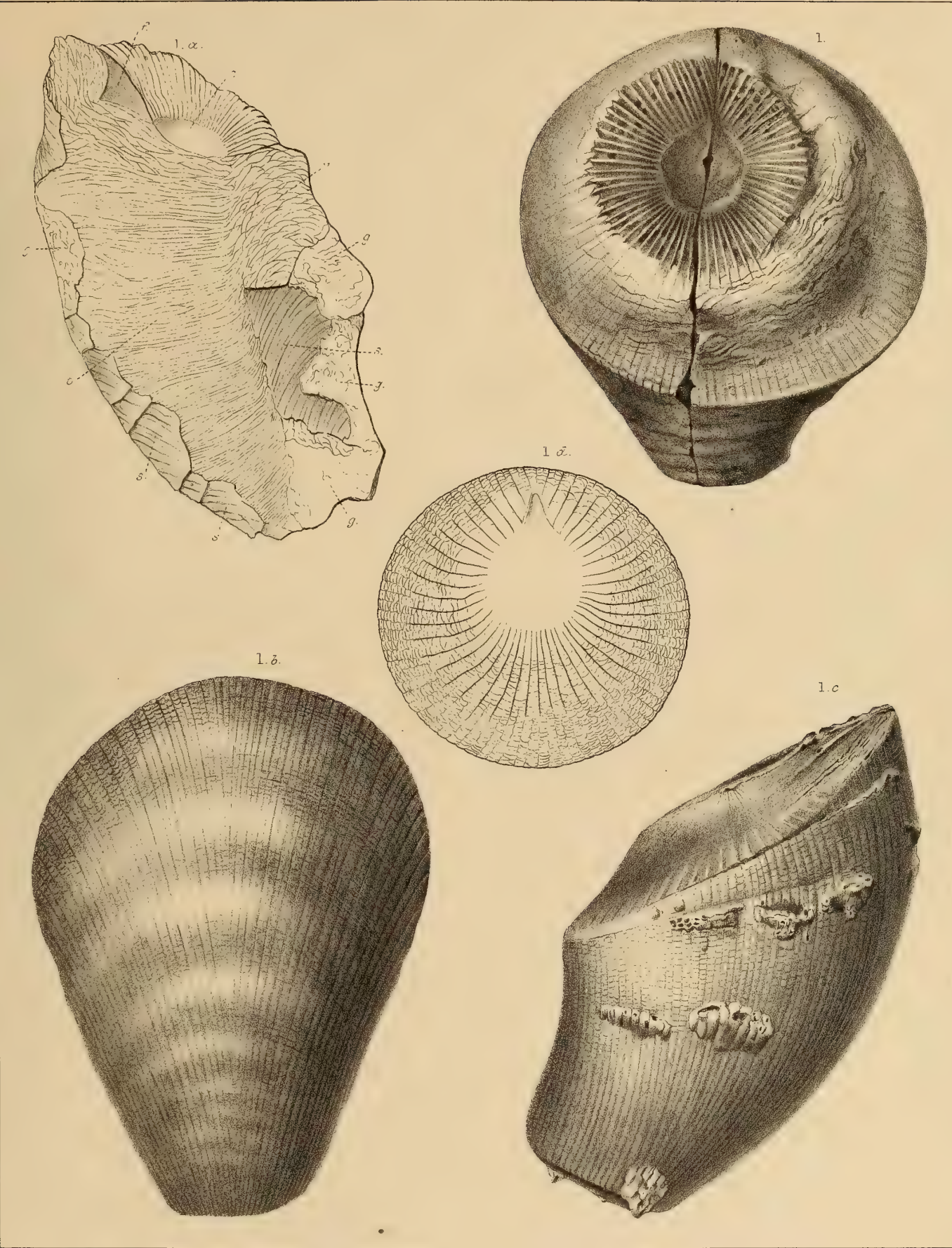


PLATE V.

	Page.
Fig. 1. ZAPHRENTIS? (undt. sp.)	58
1. A side view of a portion of the corallum, natural size.	
Fig. 2. CAMPOPHYLLUM (undt. sp.)	57
2. A side view of a weathered specimen, showing the edges of the septa (slightly too wide apart), and the crowded, complex vesicular structure between them.	
2 a. A longitudinal section of the same, showing the very broad tabulæ, surrounded by a narrow vesicular zone.	
2 b. A transverse section of same, showing the dissepiments to be (at some places) much more crowded between the septa in the vesicular zone than would be indicated by the longitudinal section.	
Fig. 3. CYATHOPHYLLUM (CAMPOPHYLLUM?) NEVADENSE	60
3. A much-weathered specimen (side view) showing the edges of the septa and dissepiments, with an oblique view of the calice filled with hard calcareous matter.	
3 a. A vertical section of a part of the same specimen, showing the tabulæ and vesicular dissepiments represented by dark lines, as far as they can be made out. The dark space above shows the very deep calice (with a nearly flat bottom) filled with dark calcareous matter.	
3 b. Is a transverse section at near the middle of the corallum.	
Fig. 4. CYATHOPHYLLUM SUBCÆSPITOSUM	60
4. A specimen consisting of several corallites lying together in the matrix, with the epitheca mainly removed by weathering.	
4 a. A transverse section of one of the same.	
4 b. A longitudinal section of a part of same.	

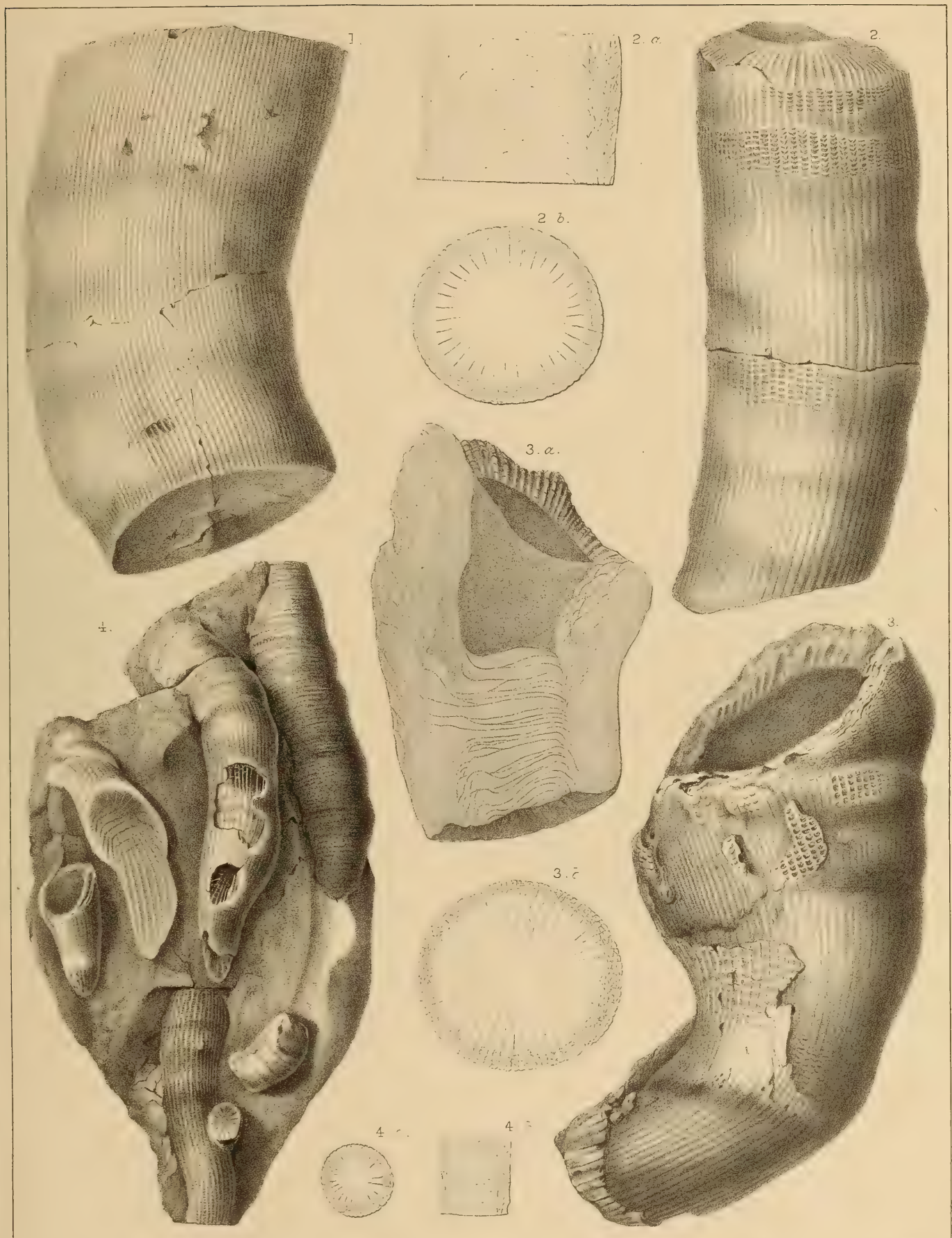


PLATE VI.

	Page.
Fig. 1. LITHOSTROTION WHITNEYI	58
1. A view of a mass of limestone including several of the corallites, natural size.	
1 a. Another view of same, showing the ends and calices of the corallites.	
1 b. A transverse section of one of the same, somewhat enlarged.	
1 c. A longitudinal section of same.	
Fig. 2. SYRINGOPORA (undt. sp.)	50
2. A side view of a fragment of the corallum.	
2 a. Another view of same specimen, showing the ends of the corallites.	
Fig. 3. ZAPHRENTIS STANSBURYI	54
3. A side view of an imperfect specimen, with the edges of the calice and the lower extremity broken away.	
3 a. An upper view of same, showing the septa, with the remaining portion of the calice filled with rock.	
3 b. A transverse section of the corallum below the middle.	
3 c. A longitudinal section of the upper part of the same, showing the complex tabulæ and outer vesicular zone, the form of the broad bottom of the calice, etc.	
Fig. 4. ZAPHRENTIS? (CLISIOPHYLLUM?) MULTILAMELLOSA	53
4. A dorsal view of a specimen denuded of its epitheca, and showing the divaricating arrangement of the septa.	
4 a. A view of the calice of same, with its margins broken away and its bottom filled with rock.	
4 b. A longitudinal broken section of same, showing imperfectly the internal structure, with the fossula on the right.	

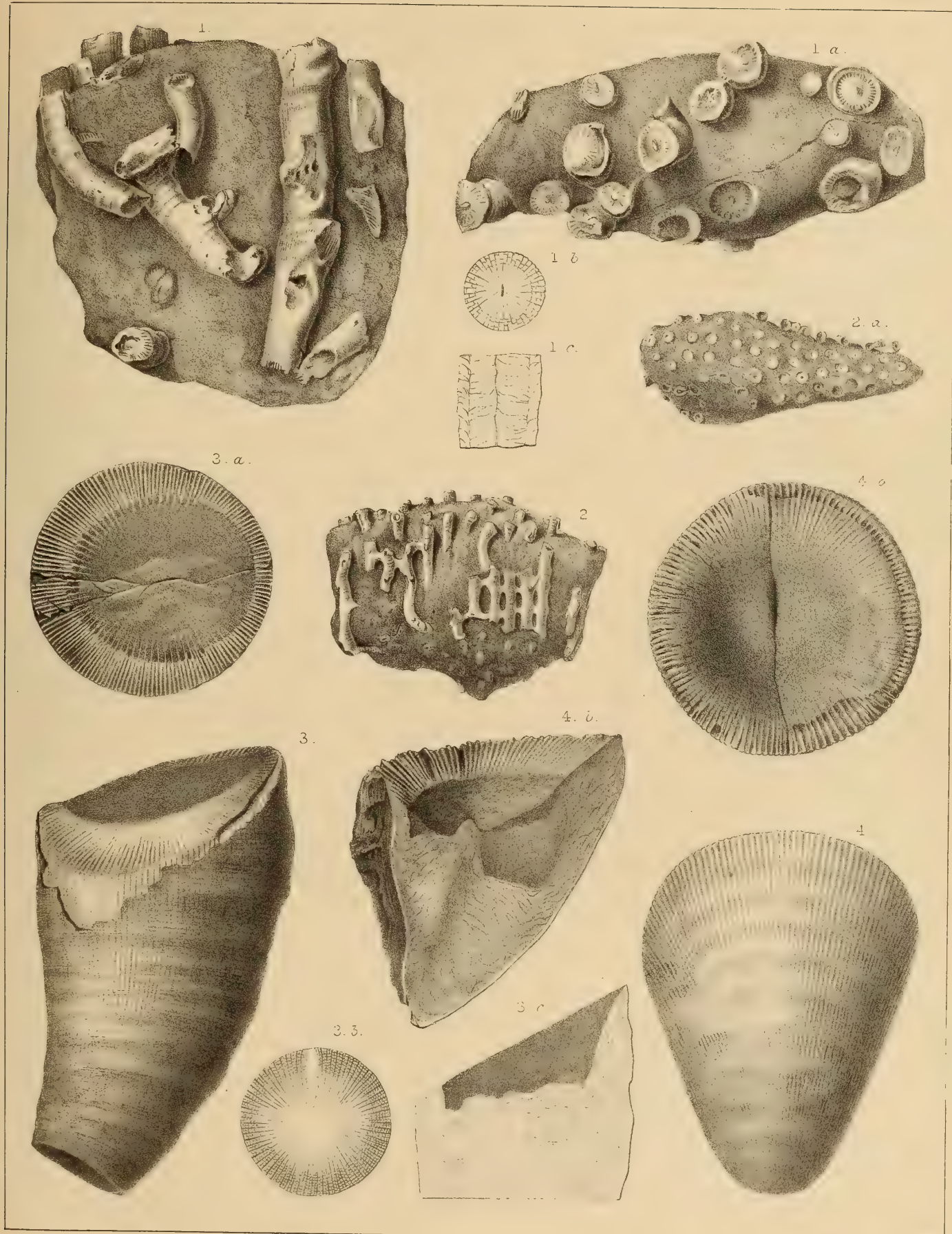
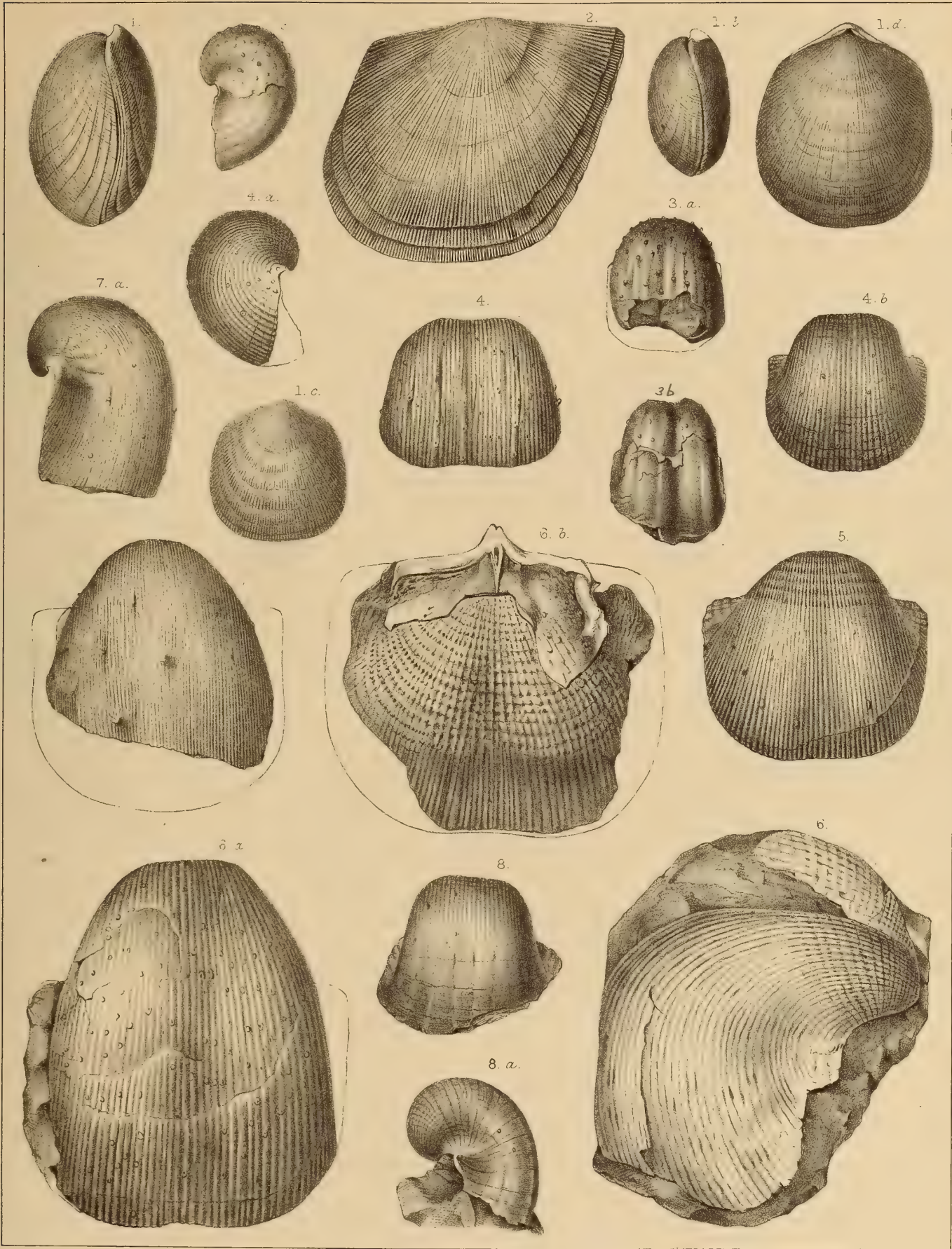


PLATE VII.

	Page.
Fig. 1. <i>ORTHIS MICHELINI</i> var. <i>NEVADENSIS</i>	63
1. A side view of a large specimen. [Beak of ventral valve not quite arched enough, and the height of the area of the dorsal valve not well shown, in this figure.]	
1 a. A dorsal view of same. [Figure makes the cardinal area look too wide.]	
1 b. A side view of a smaller specimen.	
1 c. A ventral view of same. [Posterior lateral striæ too straight in this figure and 1 a.]	
Fig. 2. <i>HEMIPRONITES CRENISTRIA</i>	62
2. A ventral view of an accidentally distorted specimen.	
Fig. 3. <i>PRODUCTUS SUBHORRIDUS</i>	75
3. A side view.	
3 a. A front view of another specimen.	
3 b. A ventro-anterior view of another example.	
Fig. 4. <i>PRODUCTUS COSTATUS</i> ??	69
4 An anterior view; the shell being turned so as to show the irregularity of the costæ on the anterior slope.	
4 a. A side view.	
4 b. A ventral view.	
Fig. 5. <i>PRODUCTUS SEMIRETICULATUS</i>	69
5. View of ventral valve.	
Fig. 6. <i>PRODUCTUS</i> longus ^{<i>longus</i>}	67
6. An oblique side view of a large specimen distorted by pressure.	
6 a. A ventral view of another specimen, with its ears and margins broken away.	
6 b. An external cast of the dorsal valve, with some portions of the shell remaining near the cardinal margin, showing the thick marginal ridge, and a part of the cardinal process, with the small mesial ridge, which latter is divided near the cardinal process, as in <i>P. scabriculus</i> .	
Fig. 7. <i>PRODUCTUS PRATTENIANUS</i>	72
7. A ventral view of an imperfect specimen, with the ears and free margins broken away.	
7 a. A side view of another imperfect specimen.	
Fig. 8. <i>PRODUCTUS SEMISTRIATUS</i>	74
8. An antero-ventral view.	
8 a. A side view of same.	



P L A T E V I I I .

	Page.
Fig. 1. <i>SPIRIFERINA PULCHRA</i>	85
1. Dorsal view of the original typical specimen.	
1 a. Ventral view of same.	
1 b. An outline profile of same.	
1 c. An internal cast of the ventral valve, showing the slit left by the rostral septum.	
1 d. A dorsal view of another very gibbous specimen.	
1 e. An outline profile of same.	
Fig. 2. <i>PRODUCTUS NEVADENSIS</i>	64
2. Ventral view of a specimen, with the ears broken away.	
2 a. Cast of the exterior of a ventral valve of same species.	
2 b. Ventral aspect of another specimen, turned so as to give a more direct view than fig. 2.	
2 c. Internal cast of ventral valve.	
2 d. A side view of same.	
2 e. A longitudinal section of a specimen with the valves united.	
Fig. 3. <i>PRODUCTUS MULTISTRIATUS</i>	76
3. Ventral view of a rather large specimen, with the free margins broken away.	
3 a. Side view of same.	
3 b. Ventral view of a smaller specimen, with one ear and much of the margins broken away.	
3 c. Dorsal view of last.	
3 d. Side view of same.	
3 e. Internal view of a dorsal valve, too much worn to show internal markings, but showing the very abrupt geniculation of the anterior and lateral margins around the flattened visceral region.	
Fig. 4. <i>PRODUCTUS LONGISPINUS</i>	78
4. A side view.	
4 a. Ventral view, with ears partly broken away.	
Fig. 5. <i>SPIRIFERINA</i> (undt. sp.)	84
5. Dorsal view of a specimen, with lateral extremities imperfect.	
5 a. Antero-ventral aspect of same.	
5 b. A side view of same.	
Fig. 6. <i>ATHYRIS SUBTILITA</i>	83
6. Dorsal view.	
6 a. An outline profile of same.	

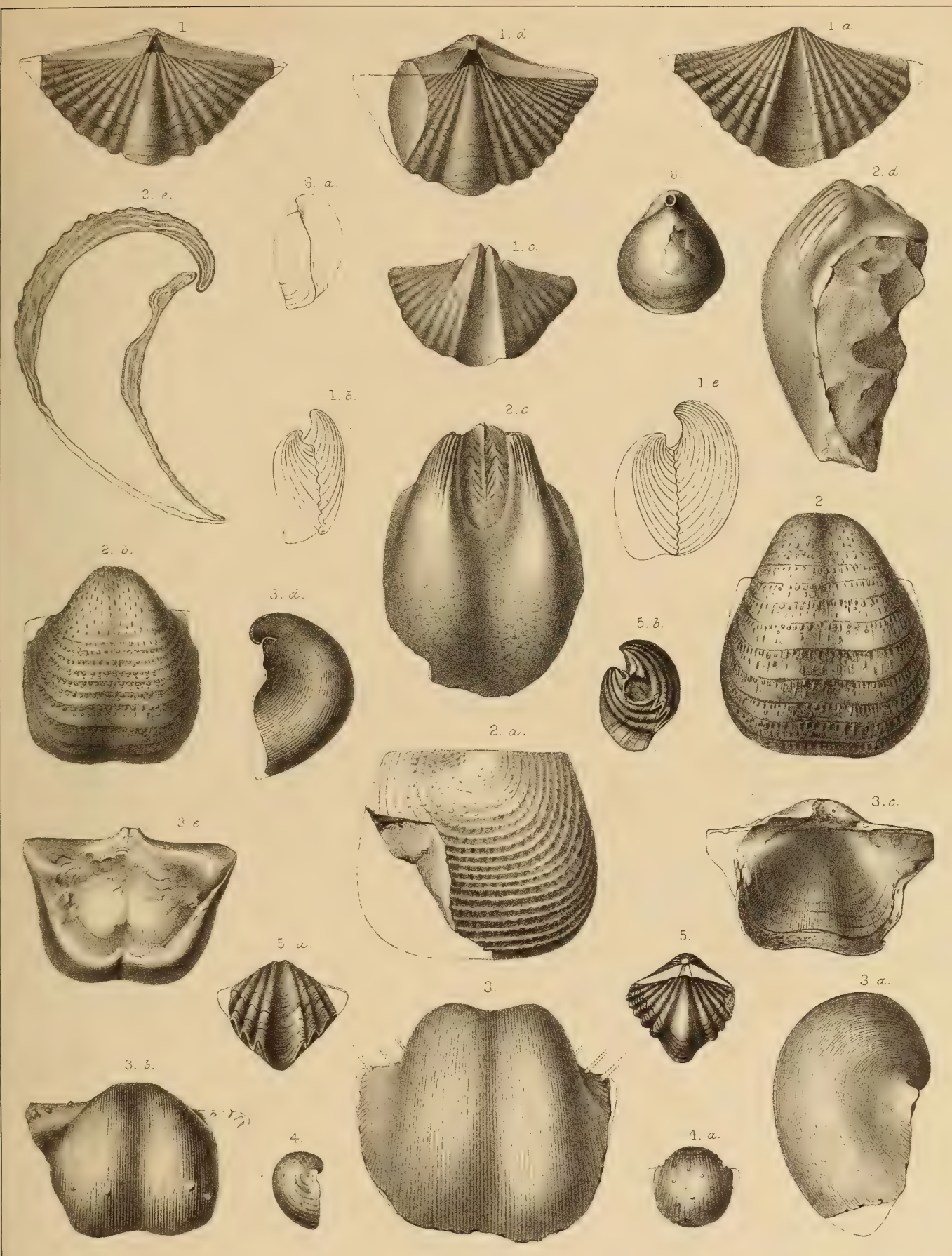


PLATE IX.

	Page.
Fig. 1. <i>SPIRIFER SCOBINA</i>	90
1. Dorsal view of a mature specimen, with the granules of the surface worn off.	
1 a. Side view of same.	
1 b. Ventral view of same.	
1 c. A portion of the granular surface magnified.	
1 d. A cardinal view of a ventral valve, showing area and foramen.	
Fig. 2. <i>SPIRIFER CAMERATUS</i> ?	91
2. Ventral view of an imperfect specimen.	
2 a. Side view of same.	
Fig. 3. <i>ATHYRIS ROISSYI</i>	82
3. A side view of a large specimen accidentally compressed.	
3 a. Ventral view of same.	
3 b. Dorsal view of same.	
Fig. 4. <i>ATHYRIS</i> ? <i>PERSINUATA</i>	81
4. An antero-ventral view, showing the profound sinus of the front.	
4 a. A dorsal view of same; a part of the shell being removed so as to show the muscular scars.	
4 b. Side view of same, with beak and contiguous parts broken away.	
Fig. 5. <i>GONIATITES GONIOLOBUS</i>	98
5. A profile view of an internal cast, with the body-chamber broken away.	
5 a. Side view of same.	
5 b. Diagram of lobes and sinuses of one of the septa, natural size.	
Fig. 6. <i>SPIRIFER OPIMUS</i> ?. A ventral view	88
Fig. 7. <i>AVICULOPECTEN UTAHENSIS</i>	95
7. A left? valve, natural size.	
7 a. A portion of the surface of same, magnified to show the minute, crowded, concentric striae.	
7 b. A mould of a larger individual in the rock.	
7 c. A mould of a small right valve of apparently the same.	
7 d. A cast of another specimen of same, differing a little in form.	

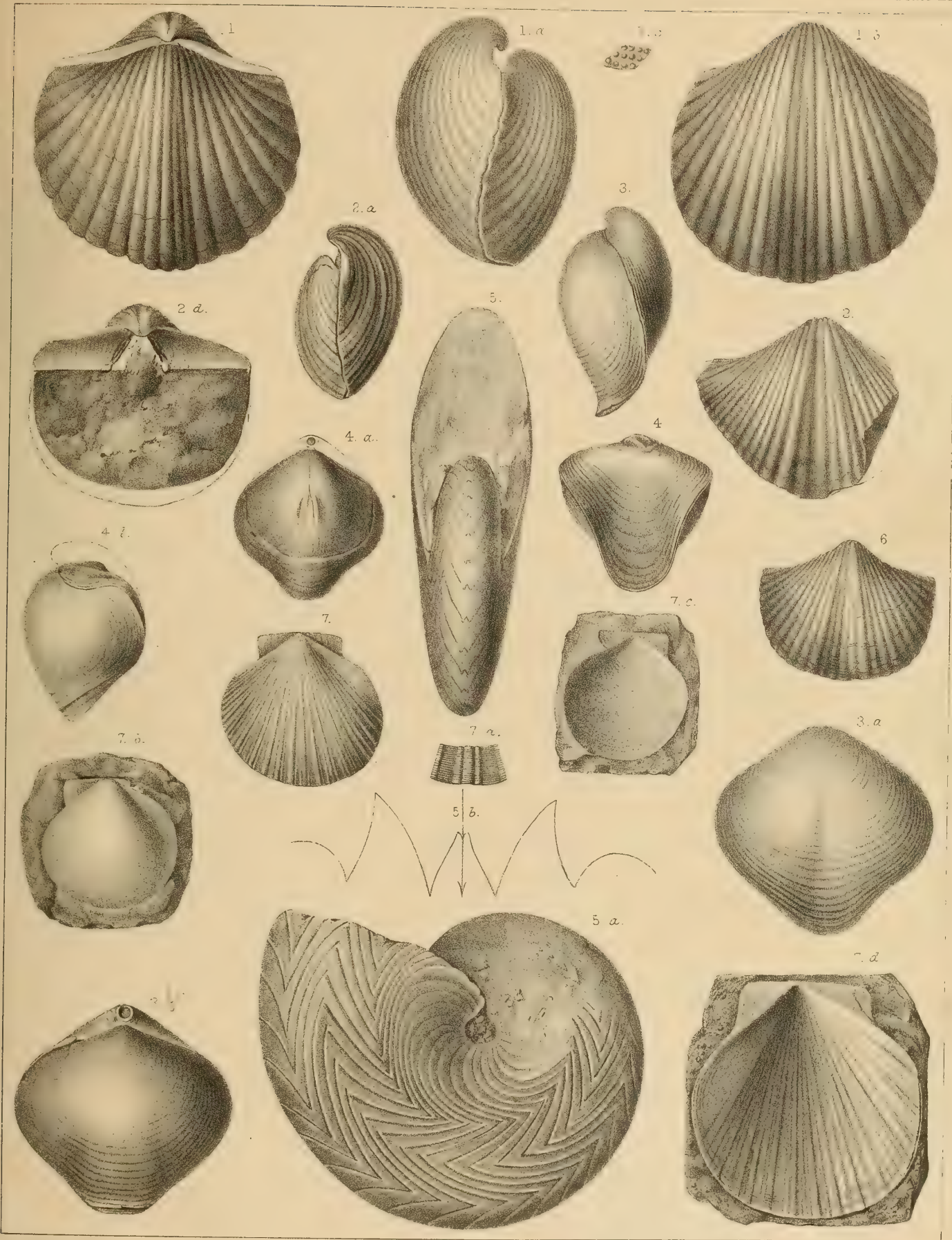


PLATE X.

	Page.
Fig. 1. MODIOMORPHA ? OVATA	103
1. Right valve; the specimen being a cast of the outside.	
1 a. A profile to show the convexity of same.	
Fig. 2. MODIOMORPHA ? LATA. An external cast of a left valve	103
Fig. 3. DISCINA (undt. sp.)	98
3. Under valve.	
3 a. Same, enlarged two diameters, and showing more nearly the proper proportions.	
Fig. 4. SPILERA WHITNEYI	102
4. A left valve of a small specimen.	
4 a. An outline to show the convexity of same.	
4 b. A right valve of a larger specimen.	
4 c. A large individual apparently of the same species.	
Fig. 5. HALOBIA LOMMELI. A slab of rock, with several imperfect valves, all being casts of the exterior.....	100
Fig. 6. ARCESTES GABBII.....	121
6. A cast of the interior, side view.	
6 a. Profile view of same.	
6 b. An outline showing the lobes and sinuses of one of the septa from the umbilicus to the siphonal lobe; taken from Mr. Gabb's figure in the California Geological Report.	
Fig. 7. CLIDONITES LÆVIDORSATUS.....	109
7. A side view of the largest specimen in the collection.	
7 a. Profile of a smaller specimen of same.	
Fig. 8. EUTOMOCERAS LAUBEI.....	126
8. A side view of an imperfect specimen.	
8 a. Profile of the same.	
Fig. 9. GYMNOTOCERAS ROTELLIFORME	111
9. Side view of an incomplete specimen.	
9 a. Profile of same.	
Fig. 10. GYMNOTOCERAS BLAKEI	113
10 Side view of an incomplete specimen.	
10 a. Profile of same.	
10 b. A smaller specimen.	
10 c. An outline of the lobes and sinuses, taken mainly from Mr. Gabb's figure in the California Geological Report.	
Fig. 11. ORTHOCERAS BLAKEI? Merely fragments of a cast, showing none of the septa	104

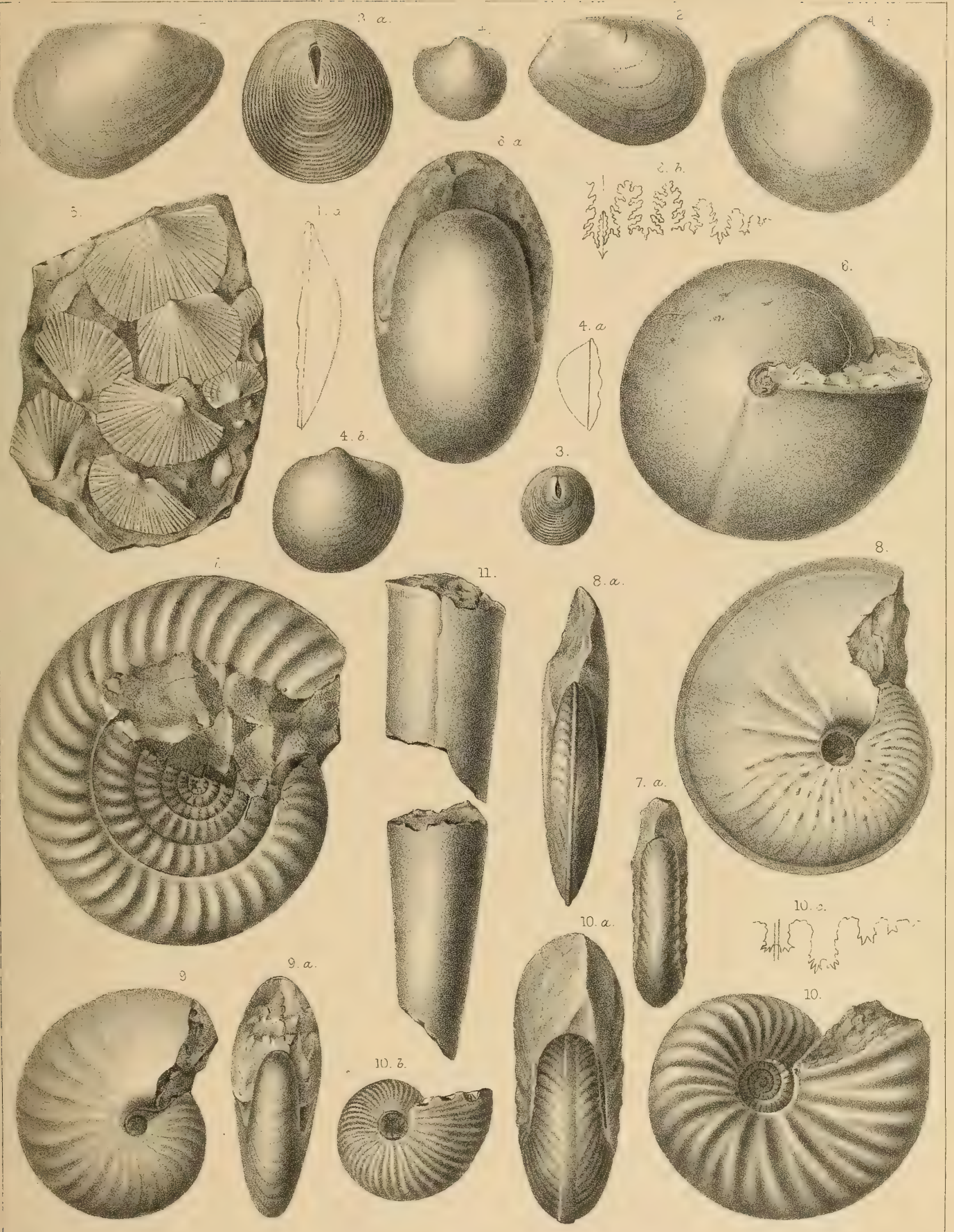


PLATE XI.

	Page.
Fig. 1. TRACHYCERAS JUDICARICUM	118
1. A peripheral or ventral view of an imperfect specimen.	
1 a. A side view of same.	
Fig. 2. TRACHYCERAS JUDICARICUM, var. SUBASPERUM	118
2. A side view of an imperfect specimen.	
2 a. A peripheral or abdominal view of same.	
2 b. A view of the lobes and sinuses of the septa.	
Fig. 3. TRACHYCERAS WHITNEYI	116
3. A peripheral or abdominal view of an imperfect specimen.	
3 a. Side view of same.	
Fig. 4. EUDISCOCERAS GABBI	128
4. Side view of an imperfect specimen.	
4 a. A peripheral or abdominal view of same.	
Fig. 5. ACROCHORDISCERAS HYATTI	124
5. Side view of a broken and somewhat distorted specimen.	
5 a. A side view of a larger imperfect specimen.	
Fig. 6. GYMNOTOCERAS BLAKEI	113
6. Side view of a nearly complete adult specimen apparently of this species.	
6 a. A peripheral or abdominal view of same, showing the remarkable flattening of the periphery.	
Fig. 7. ARCESTES? PERPLANUS	120
7. Side view of a cast, showing no surface-markings.	
7 a. A profile view, showing the strongly-compressed form of the shell.	

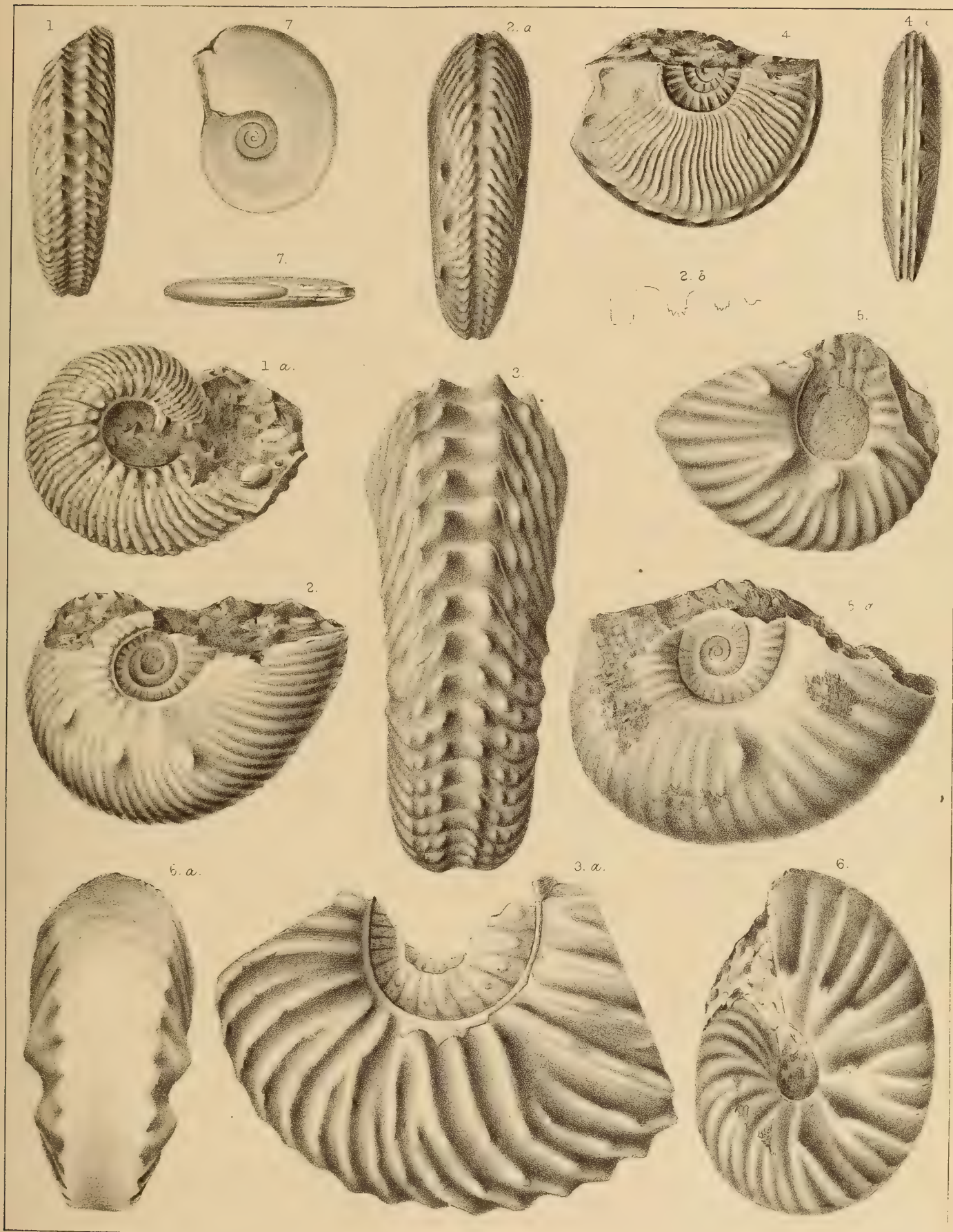
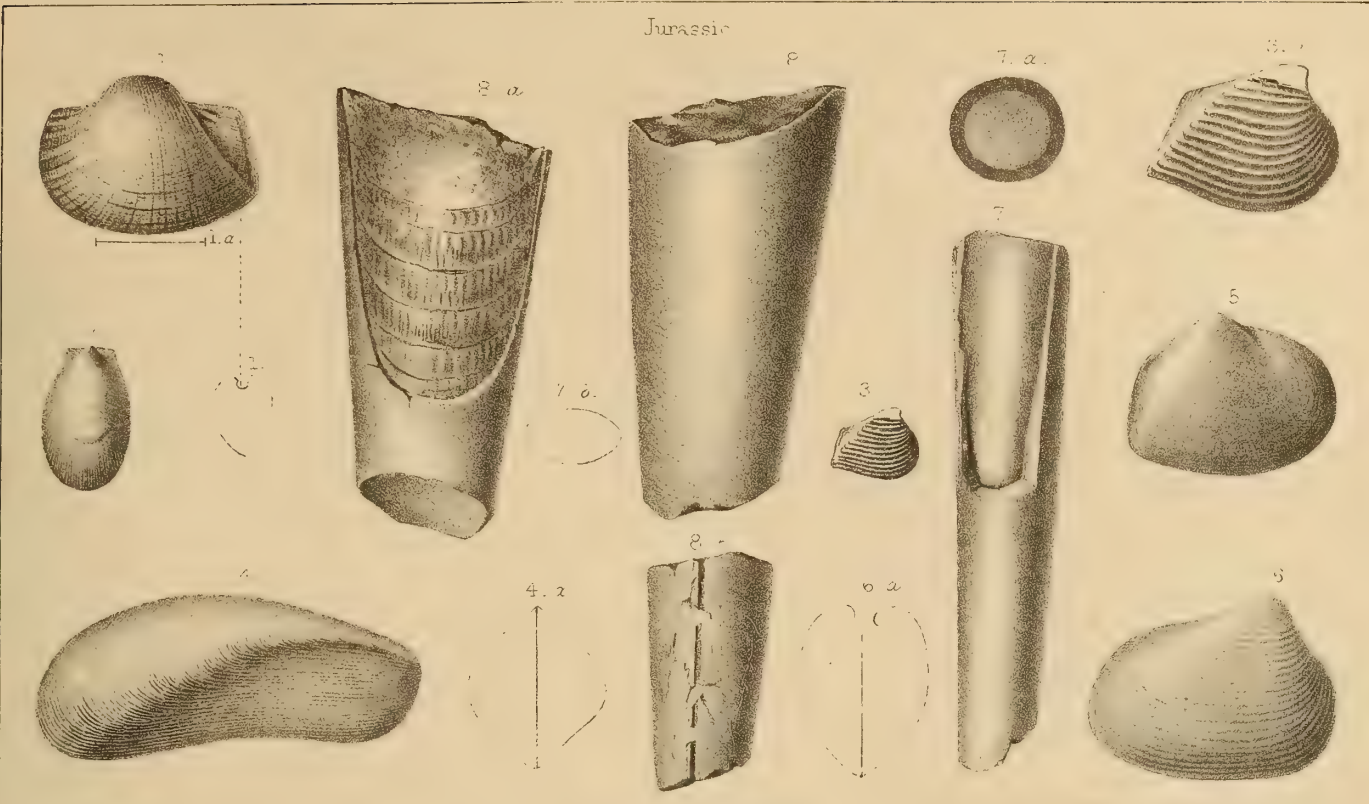


PLATE XII.

	Page.
Fig. 1. <i>CUCULLÆA HAGUEI</i>	134
1. Side view, magnified. 12540	
1 a. A line showing the natural size of same.	
1 b. An outline anterior view, to show the convexity of the shell, natural size.	
Fig. 2. <i>LIMA (LIMATULA) ERECTA</i> . A single valve, natural size.....	130
Fig. 3. <i>MYOPHORIA LINEATA</i> ?.....	133
3. A specimen with the beak broken away, natural size.	
3 a. The same, magnified.	
Fig. 4. <i>VOLSELLA SCALPRUM</i> , var. <i>ISONEMA</i>	132
4. Side view, natural size.	
4 a. An outline to show convexity.	
Fig. 5. An undetermined bivalve (internal cast).	
Fig. 6. <i>MYACITES (PLEUROMYA) SUBCOMPRESSA</i>	136
6. Side view.	
6 a. An outline to show convexity.	
Fig. 7. <i>BELEMNITES NEVADENSIS</i>	138
7. An imperfect specimen, with the lower extremity broken away. It also has a part of one side broken out, so as to show the cast of the internal cavity for the reception of the phragmocone.	
7 a. Is a section across the upper end, showing the form of the upper part of the internal cavity.	
7 b. An outline to show the compressed form of the guard near its lower end.	
Fig. 8. Phragmocone of apparently a large <i>Belemnite</i>	139
8 a. Another view of same, with a part of one side removed, so as to show the deeply arcuate septa.	
8 b. Another fragment, showing the marginal siphuncle.	
Fig. 9. <i>PINNA KINGII</i>	131
9. A side view of an imperfect cast, retaining portions of the shell.	
9 a. Dorsal view of same.	
Fig. 10. <i>MYACITES INCONSPICUUS</i> . A side view, magnified two diameters.....	137
Fig. 11. <i>MYACITES (PLEUROMYA) WEBERENSIS</i>	137
11. Side view of a specimen with the posterior end broken away.	
11 a. Anterior view of same.	
Fig. 12. <i>SPIRIFERINA PULCHRA</i>	85
12. A side view of a specimen, with the extremities and beak broken away.	
12 a. A cardinal view of same, showing area and foramen.	
12 b. An anterior view of same.	
12 c. A dorsal view of another specimen, with imperfect extremities.	
12 d. A nearly complete ventral valve, as seen embedded in the matrix.	
Fig. 13. <i>AVICULOPECTEN OCCIDANEUS</i>	96
13. A specimen of left valve, with the anterior ear broken away, natural size.	
13 a. Another specimen of left valve, figure enlarged two diameters.	
13 b. Another specimen, apparently of left valve, with posterior ear more acute.	

Jurassic



Carboniferous and Jurassic

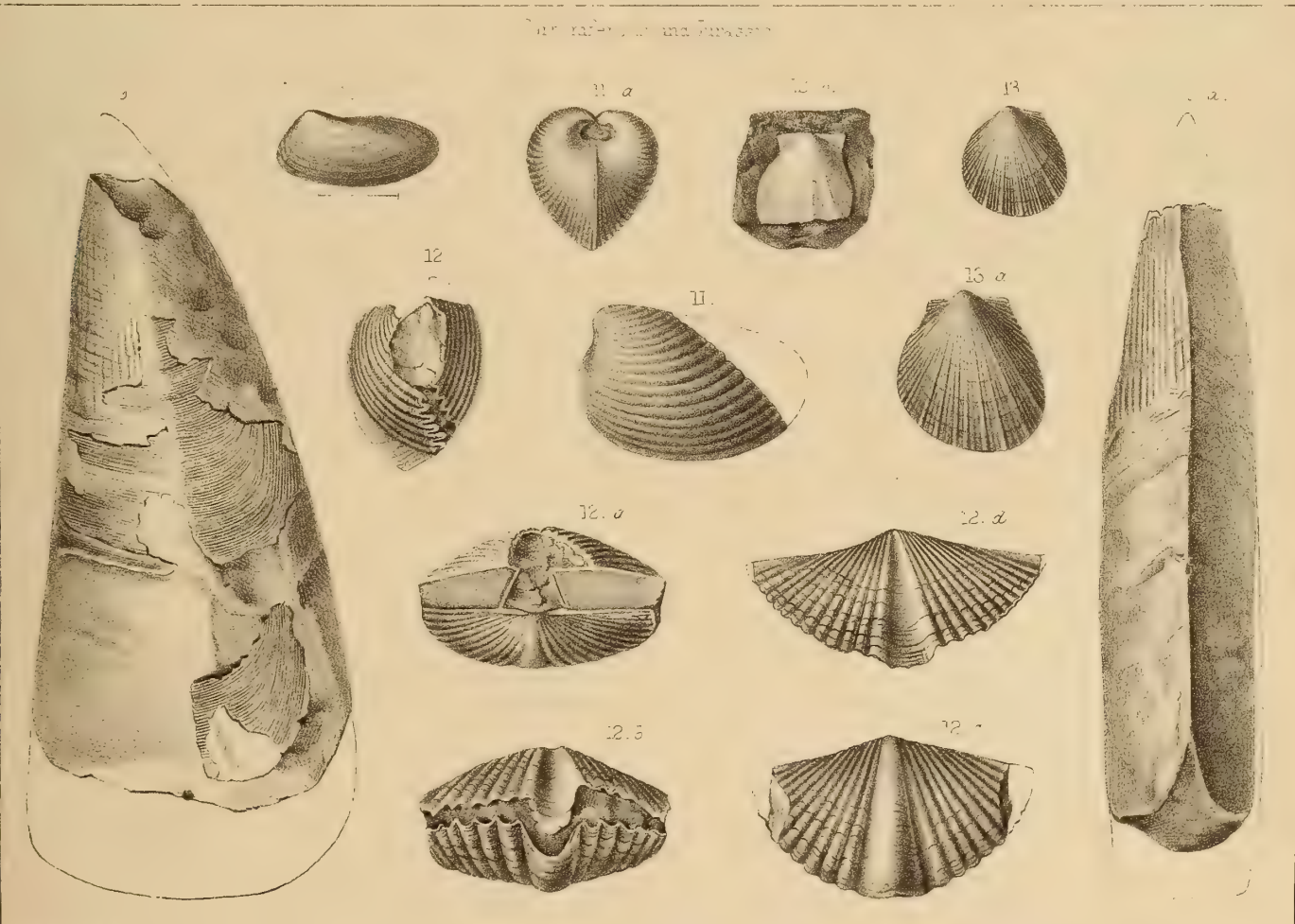
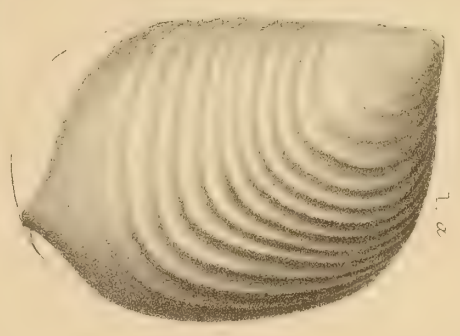
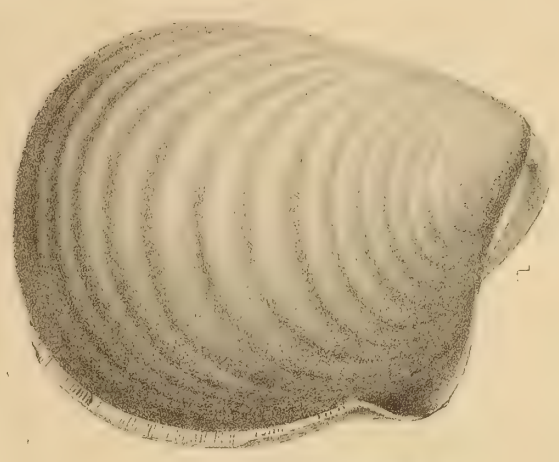


PLATE XIII.

	Page.
Fig 1. INOCERAMUS ERECTUS.....	145
1. A side view of an internal cast of both valves, somewhat distorted.	
1 a. Another small cast of a left valve.	
Fig. 2. INOCERAMUS PROBLEMATICUS?.....	143
2 a. Cast of a light valve.	
2 b. A part of an internal cast of a form with a more pointed beak (partly due to distortion), possibly belonging to another species.	
Fig. 3. INOCERAMUS SIMPSONI. An internal cast of a right valve, with some remaining portions of the shell. Portions of the basal and posterior dorsal margins being broken away.....	142
Fig. 4. INOCERAMUS (undt. sp.), side view.....	144
4 a. A profile outline of same.	



3.

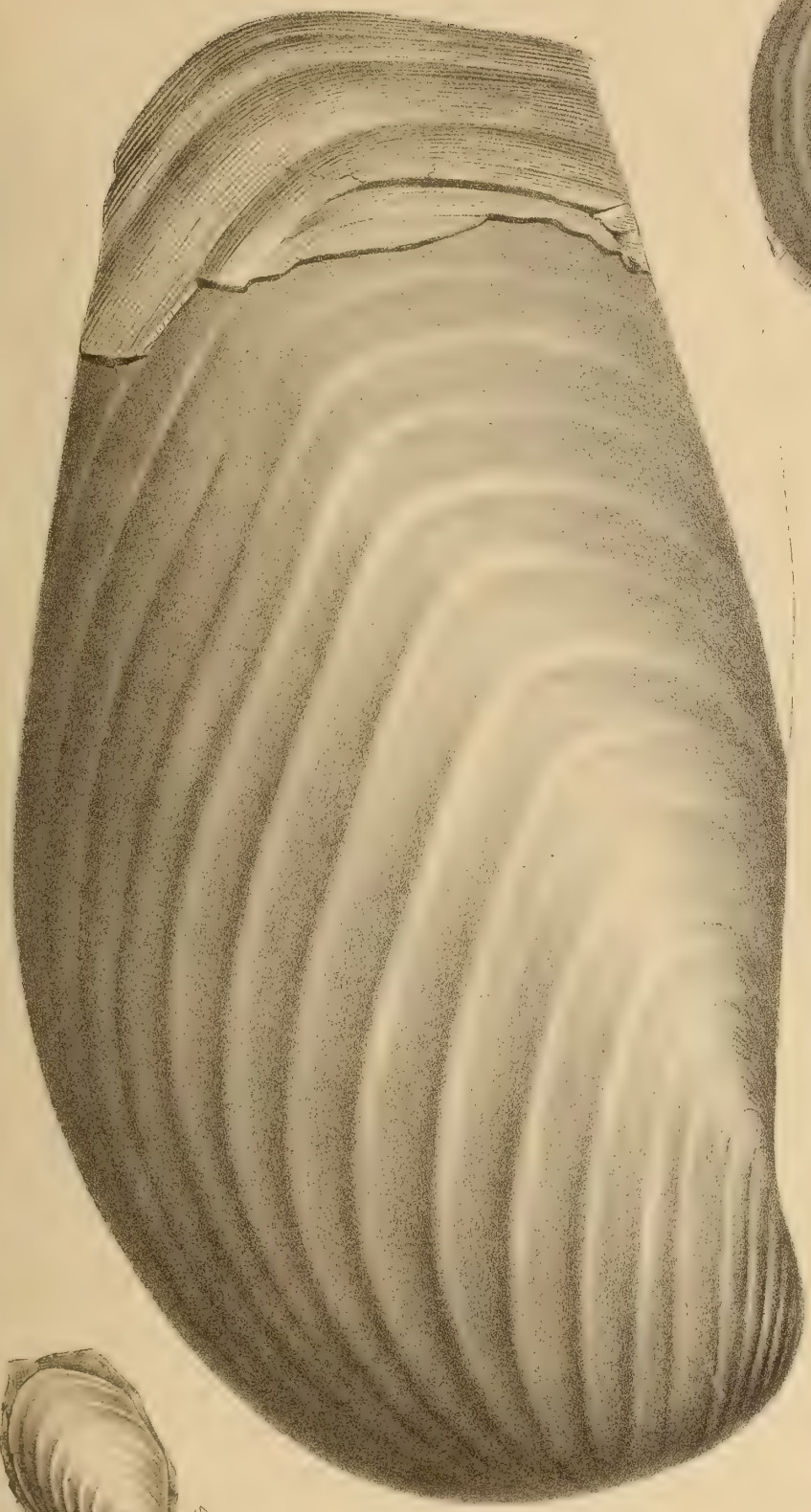




PLATE XIV.

	Page.
Fig. 1. CUCULLÆA (TRIGONARCA?) OBLIQUA.....	148
1. Internal cast of a left valve.	
1 a. Another larger one of same.	
1 b. A cast of right valve of same.	
Fig. 2. CORBULA (cast in sandstone).....	150
Fig. 3. INOCERAMUS ERECTUS. An anterior view of an internal cast of the two valves partly opened. Their lower margins are distorted, and probably were originally as broad as indicated by the outlines below.	145
Fig. 4. INOCERAMUS DEFORMIS.....	146
4. Cast of a right valve, with a part of the anterior margin and beak broken away.	
4 a. Another view of same.	
Fig. 5. MACTRA (TRIGONELLA?) ARENARIA.....	154
A view of the exterior of the left valve.	

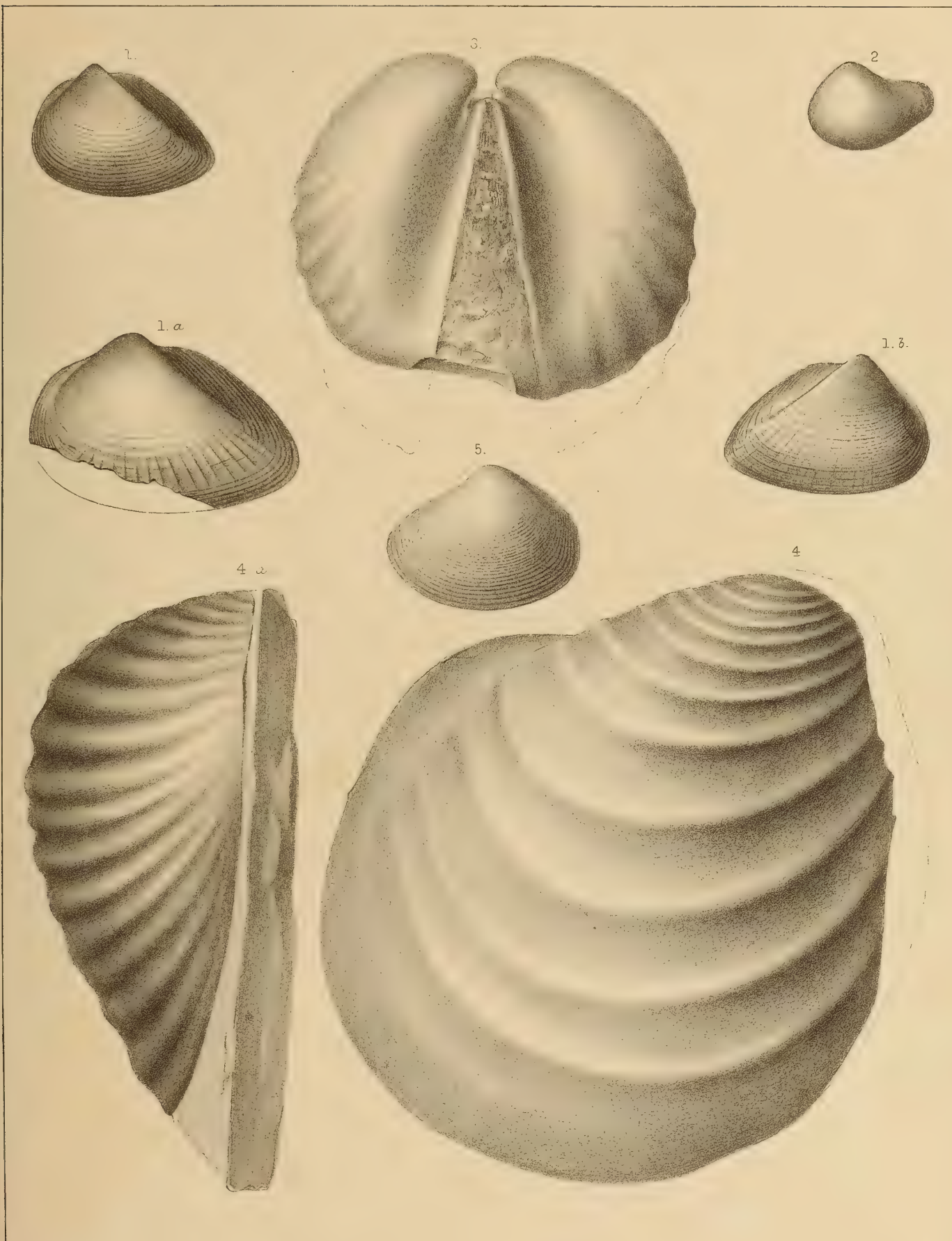


PLATE XV.

	Page.
Fig. 1. <i>GYRODES DEPRESSA</i>	159
1. Upper view of an internal cast.	
1 a. Side view of same.	
Fig. 2. <i>ANCHURA? FUSIFORMIS</i>	160
2. External cast of a specimen with the apex of the spire broken away, and the outline of the lip not clearly seen.	
2 a. A smaller specimen, with the lip and the extremity of the canal broken away.	
Fig. 3. <i>CARDIUM CURTUM</i>	151
Left view of one of the largest specimens, which is an internal cast.	
Fig. 3 a. <i>CARDIUM SUBCURTUM</i>	152
A small specimen, right side view.	
Fig. 4. <i>TELLINA MODESTA</i> . Cast of left valve	157
✓ Fig. 5. <i>TELLINA? MODESTA</i> . Cast of a larger left valve, possibly of this species	157
Fig. 6. <i>TELLINA? ISONEMA</i> . Left view of a cast of exterior	156
✓ Fig. 7. <i>CYPRIMERIA? SUBALATA</i> . Internal cast of left valve	158
Fig. 8. <i>MACTRA? EMMONSI</i> . Cast of outside of left valve, two diameters	153
Fig. 9. <i>TELLINA (ARCOPAGIA)? UTAHENSIS</i>	155
9. Cast of right valve.	
9 a-b. Two other casts of right valves, differing somewhat in form, but probably belonging to the same species.	
Fig. 10. <i>OSTREA</i>	140
10. Interior of an upper valve.	
10 a. Outer or upper side of same.	
10 b. Interior of an under valve.	
10 c. Outside of same.	

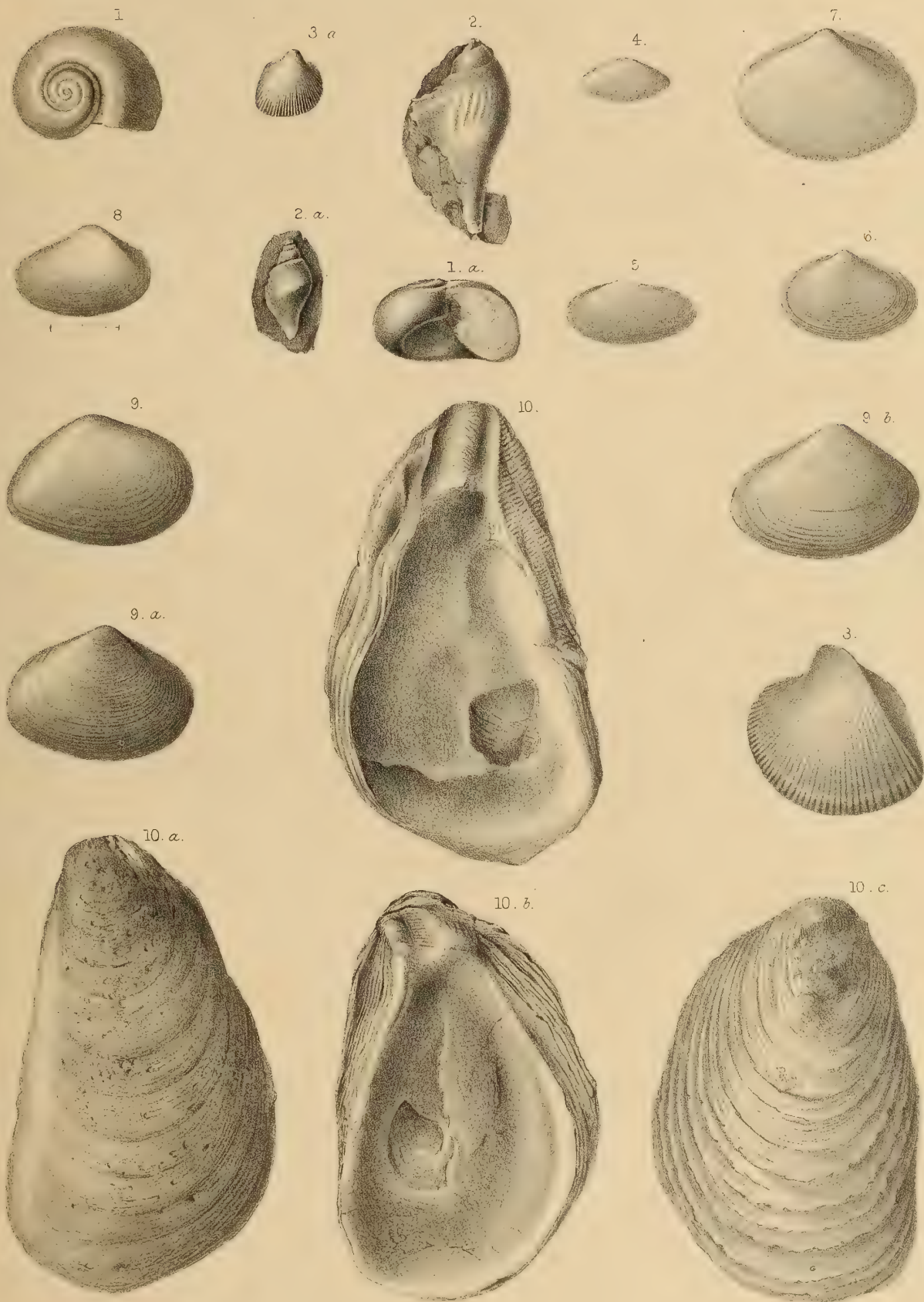


PLATE XVI.

	Page.
Fig. 1. SPHÆRIUM? IDAHOENSE.....	183
1. A specimen consisting mainly of an internal cast, with some portions of the shell remaining.	
1 a. An outline to show the convexity of the same.	
Fig. 2. SPHÆRIUM RUGOSUM	182
2. A rather small specimen, enlarged two diameters.	
2 a. A larger specimen, enlarged two diameters.	
2 b. An outline to show convexity, enlarged two diameters.	
Fig. 3. UNIO HAYDENI.....	184
3. View of left valve.	
3 a. Same view of a larger specimen.	
3 b. Internal cast, showing an impression of the hinge.	
Fig. 4. UNIO BELLIPLICATUS.....	165
4. Left side of one of the larger specimens.	
4 a. Right view of a smaller individual of same.	
Fig. 5. UNIO VETUSTUS	16
5. A young shell flattened by pressure, with a part of the posterior broken away. (Original type of the species.)	
5 a. A large specimen, somewhat twisted over by oblique pressure, so as to hide the beaks.	
5 b. A dorsal view of same.	
5 c. A smaller specimen of same.	
Fig. 6. CYRENA (VELORITINA) DURKEEI	167
6. A medium-sized specimen.	
6 a. An anterior view of same, showing its unusually deep and well-defined lunule.	
6 b. A larger individual.	
6 c. A very gibbous, short variety.	
6 d. A dorsal view of same, showing the deep posterior dorsal concavity.	
6 e. A separate left valve, showing hinge.	
6 f. A small, depressed variety, or possibly a distinct species.	
6 g. An internal cast, showing muscular impression, and the slightly sinuous pallial line.	

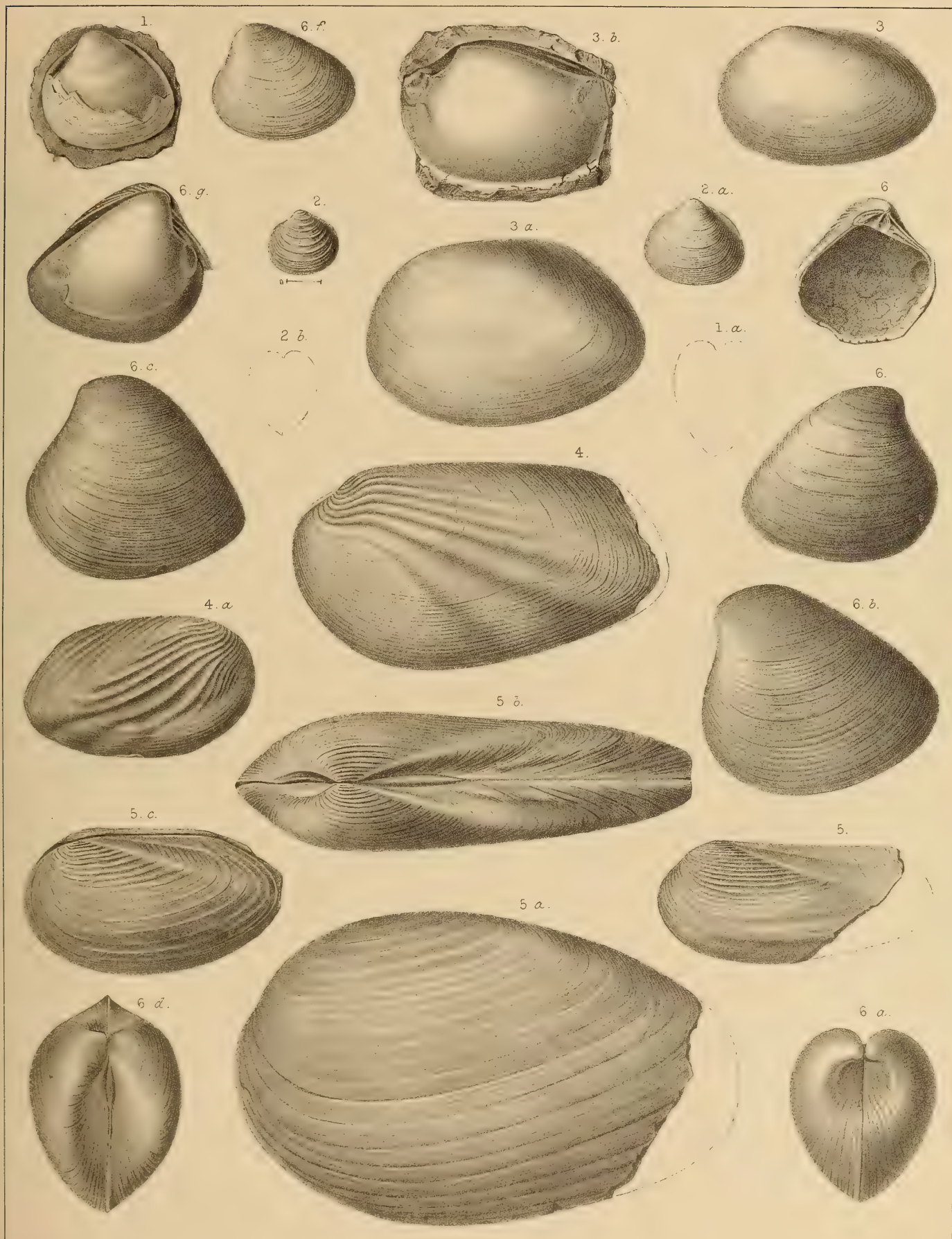


PLATE XVII.

	Page.
Fig. 1. <i>CORBULA ENGELMANNI</i>	174
1. A large specimen, with a part of posterior extremity broken off.	
1a. The original typical specimen, enlarged two diameters.	
Fig. 2. <i>CORBULA PYRIFORMIS</i>	170
2. A side view of a rather distinctly ribbed specimen, with a portion of its posterior extremity broken away, natural size.	
2a. The original typical specimen, smooth variety.	
2b. An anterior view of same, showing its very nearly equivalve character.	
2c. A very large, irregularly ribbed specimen, with the posterior extremity slightly broken.	
2d. A dorsal view of another specimen, slightly distorted by compression. It shows the posterior dorsal furrow and the angle along the margin of each valve.	
Fig. 3. <i>LIMNÆA SIMILIS</i>	191
3. A dorsal view, showing aperture, enlarged two diameters.	
3a. An opposite view of same.	
Fig. 4. <i>LIMNÆA VETUSTA</i>	191
4. A dorsal view, natural size.	
4a. The same, somewhat enlarged.	
4b. An opposite view of same, enlarged.	
Fig. 5. <i>LIMNÆA NITIDULA</i>	181
5. Dorsal view, enlarged two diameters. [Inner lip not well shown.]	
5a. An opposite view of same.	
Fig. 6. <i>RHYTIPHORUS PRISCUS</i>	175
6. View of dorsal side (type-specimen).	
6a. An opposite view of same, showing the narrow aperture, with a part of the lip broken away.	
Fig. 7. <i>GONIOBASIS SIMPSONI</i>	193
7. One of the typical specimens, natural size, with apex broken away.	
7a. A specimen without regular costa.	
7b. An opposite view of same.	
7c. A nearly smooth specimen.	
7d. A costate and slightly nodose specimen, enlarged about two diameters.	
Fig. 8. <i>MELANIA ? SCULPTILIS</i>	195
Side and aperture view, enlarged about two diameters.	
Fig. 9. <i>MELANIA ? SUBSCULPTILIS</i> ; perhaps only a variety of last.....	196
Side and aperture view, about two diameters.	
Fig. 10. <i>CARINIFEX (VORTICIFEX) TRYONI</i>	188
10. Side and aperture view, natural size.	
10a. View of upper side of same.	
10b. Under view of same.	
10c. A young, strongly costate specimen, with the apex much depressed, being the type of the var. <i>concava</i> .	
Fig. 11. <i>CARINIFEX (VORTICIFEX) BINNEYI</i>	187
11. Side and aperture view, natural size.	
11a. View of upper side of same.	
Fig. 12. <i>ANCYLUS UNDULATUS</i>	186
12. A medium-sized specimen, natural size, dorsal view.	
12a. An outline lateral view of same.	
12b. An outline lateral view of a larger specimen, natural size.	

Fig. 13. PLANORBIS SPECTABILIS	Page. 189
13. A small specimen (under side view).	
13 a. A profile view of same.	
13 b. An upper view of same.	
13 c. A profile view of a larger specimen.	
13 d. An upper view of a large distorted specimen.	
13 e. View of under side of same.	
13 f. An under view of a smaller specimen.	
Fig. 14. PLANORBIS SPECTABILIS, var. UTAHENSIS	190
14. Upper side, natural size.	
14 a. Under side, same.	
14 b. Upper side view of another specimen.	
14 c. Profile view of same specimen represented by fig. 14.	
Fig. 15. CAMPELOMA (undt. sp.)	181
15. A large, imperfect specimen, somewhat distorted (widened) by compression (lines of growth too strong and too straight), so as to appear rather wider than natural.	
15 a. An opposite view of same specimen.	
Fig. 16. Probably the young of the above species	
16 a. Another view of another specimen.	
16 b. Another specimen, with the spire broken away.	
Fig. 17. CAMPELOMA MACROSPIRA? (young specimen)	179
17. A dorsal view.	
17 a. An opposite view of same.	
Fig. 18. VIVIPARUS CONRADI?	178
18. An imperfect specimen from Bear River, Utah.	
18 a. A specimen from the original locality on the Upper Missouri, figured here for comparison.	
Fig. 19. PYRGULIFERA HUMEROSA	176
19. A large specimen, with the lip broken, so as to give an unnatural angularity to the basal outline.	
19 a. Another specimen, with the apex of the spire broken off, but showing the form of the aperture.	



LIST OF PLATES.

The plates accompanying this volume were engraved and printed by JULIUS BIEN, of New York. The original drawings for Part I were executed by H. W. ELLIOTT, of Washington; those of Part II, by H. M. MARTIN, of Albany.

PART I.

PLATE I.....	SILURIAN AND DEVONIAN SPECIES.
II.....	DEVONIAN SPECIES.
III.....	DEVONIAN AND CARBONIFEROUS (?) SPECIES.
IV.....	CARBONIFEROUS SPECIES.
V.....	CARBONIFEROUS SPECIES.
VI.....	CARBONIFEROUS SPECIES.
VII.....	CARBONIFEROUS SPECIES.
VIII.....	CARBONIFEROUS SPECIES.
IX.....	CARBONIFEROUS SPECIES.
X.....	TRIASSIC SPECIES.
XI.....	TRIASSIC SPECIES.
XII.....	JURASSIC AND CARBONIFEROUS SPECIES.
XIII.....	CRETACEOUS SPECIES.
XIV.....	CRETACEOUS SPECIES.
XV.....	CRETACEOUS SPECIES.
XVI.....	CRETACEOUS AND TERTIARY SPECIES.
XVII.....	CRETACEOUS AND TERTIARY SPECIES.

PART II.

I.....	PRIMORDIAL AND SILURIAN SPECIES.
II.....	PRIMORDIAL AND SILURIAN SPECIES.
III.....	DEVONIAN SPECIES.
IV.....	WAVERLY SPECIES.
V.....	LOWER CARBONIFEROUS SPECIES.
VI.....	UPPER CARBONIFEROUS AND TRIASSIC.
VII.....	JURASSIC SPECIES.

OFFICE OF THE U. S. GEOLOGICAL EXPLORATION
OF THE FORTIETH PARALLEL,
New York, April, 1877.

GENERAL: Herewith I have the honor to transmit Volume IV of the Reports of this Exploration, composed of Memoirs on Palæontology, by Messrs. F. B. Meek, James Hall and R. P. Whitfield; also on Ornithology, by Robert Ridgway.

Very respectfully, your obedient servant,

CLARENCE KING,
Geologist-in-charge.

Brig. Gen. A. A. HUMPHREYS,
Chief of Engineers U. S. Army,
Washington, D. C.



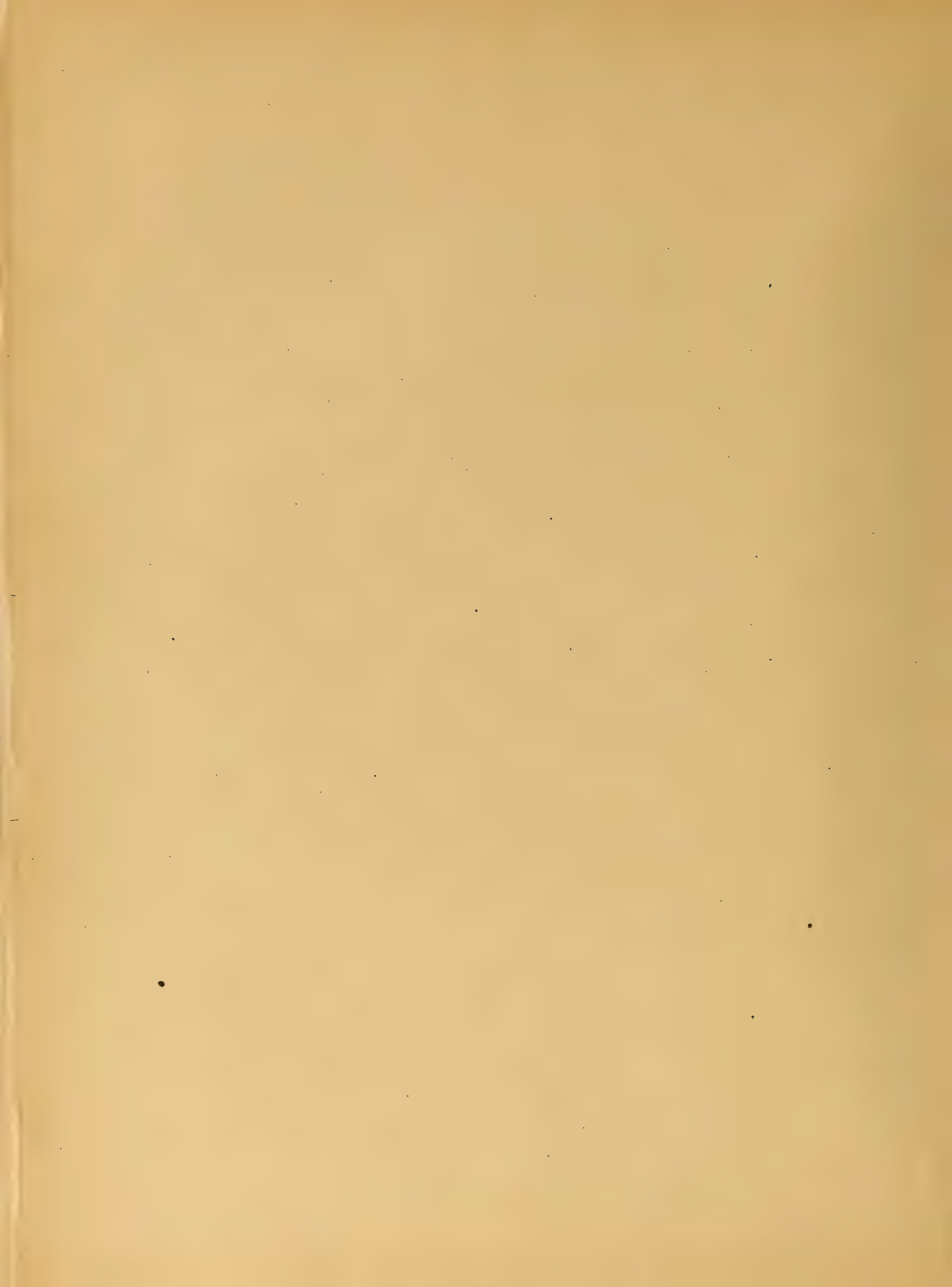
UNITED STATES GEOLOGICAL EXPLORATION OF THE FORTIETH PARALLEL.
CLARENCE KING, GEOLOGIST-IN-CHARGE.

PART I.

PALÆONTOLOGY.

BY

F. B. MEEK.



INTRODUCTORY REMARKS.

This being a strictly palæontological report, any extended remarks on the geological formations from which the fossils described were obtained are not expected, and would be out of place here. A few words, however, respecting some points on which the specimens investigated throw more or less light, seem to be necessary to a clear understanding of the palæontology itself.

Before proceeding further, however, it is proper to state here, that, in order to give as full and complete an account of the palæontology as possible of the district explored, some collections brought from the same region more than ten years since, by Col. J. H. Simpson, of the United States Topographical Engineers, while conducting a Government expedition through the same country, have also been included. In 1860, the writer published, in the Proceedings of the Philadelphia Academy of Natural Sciences, brief preliminary descriptions of the new species of fossils contained in Colonel Simpson's collection, and soon after prepared, for that gentleman's report, more extended descriptions and figures of the same. Unfortunately, however, Congress failed to make the necessary appropriation to publish Colonel Simpson's report. Consequently, the large amount of important information contained in the same remains unpublished; and, as it is now extremely improbable that his report will ever be printed,* at any rate with the accompanying illustrations, it has been thought desirable that we should give here descriptions and figures of the new fossils of his collection, now in the

* Since this was written and revised, Colonel Simpson's report has been published.

museum of the Smithsonian Institution. In doing this, however, he has been duly credited as the discoverer of each species, and the original types have generally been figured, even where specimens of the same forms are contained in Mr. King's collections; though figures of the latter have also been given, where better specimens than those first found have been obtained.

The fossils here reported on, evidently came from the following geological formations, viz., Lower Silurian, Devonian, Carboniferous, Triassic, Jurassic, Cretaceous, and Tertiary. The small number of Lower Silurian forms are represented on the upper part of plate 1. Two of the Trilobites, from Antelope Springs, House Mountains, belong, one to the genus *Conocoryphe*, and the other to the genus *Paradoxides*, or some allied group. They are decidedly Primordial types, and show that rocks belonging to this ancient period occur at that locality.*

The other Silurian forms merely consist of small univalve shells that came from a gray, granular limestone on the summit of Ute Peak, Wasatch Range, Utah. One of these is a small *Ophileta*, scarcely distinguishable from *O. complanata* of Vanuxem, first described from the Carboniferous sand-rock of New York. The other two are lenticular, or much depressed forms, with an angular periphery and a large umbilicus, and evidently belong to the same formation, being nearly allied to forms found in beds of the age of the Carboniferous period, in Minnesota, Wisconsin, and Texas. From the affinities of these fossils, we can therefore scarcely entertain any doubts that the rock from which they were obtained belongs to the Carboniferous epoch.

The Devonian forms in these collections are more numerous than the Silurian. They are illustrated on the lower part of plate 1, and on plate 2, and the upper part of plate 3. Those on plate 1, with the exception of a small *Proetus*, to be mentioned further on, came from a light-colored argillaceous limestone about three miles south of Piñon Pass, Piñon Range, Nevada, and consist of a small subglobose, undetermined species of *Favosites*, *Atrypa reticularis*, a new *Spirifer*, a bivalve of doubtful genus, and fragments of a *Dalmanites*. It is possible that the last-mentioned fossil may be an Upper Silurian species, as Mr. King found it in the lowest bed exposed at the locality, and it seems to be quite as nearly allied (so far as its charac-

* See Proceed. Acad. Nat. Sci. Philad., Ap. 1870, p. 56.

ters can be made out from the imperfect specimens) to Upper Silurian as to Devonian types. The *Spirifer*, however, is *very* closely allied to forms found in the Upper Helderberg (Devonian) limestones, at the Falls of the Ohio; while the specimens of *Atrypa reticularis* belong to a variety very common in rocks of that age in the vicinity of Louisville, Ky., and in the neighboring portions of Indiana. It is also worthy of note, that these fossils were found quite abundant, weathered out of the matrix, and that they are silicified and in all respects similar, in their state of preservation, to the Upper Helderberg fossils, so common in the Western States mentioned above. From these facts, it is highly probable that these Piñon Range fossils came from a rock belonging to about that horizon.

The other Devonian fossils, figured on plates 2 and 3, came from an entirely distinct rock from those mentioned above, and are more than usually interesting, because they were found, with a few exceptions, in the formation containing the rich silver-mines of the White Pine Mining District, Nevada. They were all found in a dark-colored or grayish matrix, entirely different from that containing the Piñon Station fossils mentioned above. Those from the White Pine District consist of several species of Corals, Brachiopods, and two species of *Orthoceras*. Among the Corals, there are species that seem to be undistinguishable from the European Devonian forms *Acervularia pentagona* and *Smithia Hennahii*. The other Corals are an apparently new *Alveolites* and a *Diphyphyllum*.* The Brachiopods consist of a small *Productus*, at least allied to the Devonian species *P. subaculeatus*, *Atrypa reticularis*, a small *Hemipronites*, apparently undistinguishable from a New York Hamilton Group species, and several small *Spirifers*, some of which resemble Hamilton Group forms.

The presence of the genera *Productus* and *Smithia* would alone be a strong argument, in the present state of palæontological science, against the supposition that these silver-bearing beds might belong to the Silurian, to say nothing of the specific affinities of these and the associated fossils; while the occurrence in the same beds of *Atrypa reticularis*, and the *Acervularia*, *Smithia*, and *Ptychophyllum*, with the specific affinities of the other fossils,

* The little *Favosites* and *Cyathophyllum*, represented by figures 2 and 3 of plate 2, are from a different horizon in Arizona.

furnish even a stronger argument against the conclusion that this formation might belong to the Carboniferous. Hence we cannot doubt that these beds belong to the Devonian, and probably to about the horizon of the Hamilton Group of the New York series.* Indeed, in 1860, on nearly the same evidence, this formation, at localities a little farther north, was referred by the writer to the Devonian, from the examination of specimens brought from there by Colonel Simpson; though at that time this rock was not known to contain silver-mines.†

The little *Proetus*, illustrated by fig. 10 on plate 1, probably also came from near the same horizon as the Devonian fossils mentioned above, as it is contained in a similar matrix quite unlike that containing the Piñon Range fossils.

On the lower part of plate 3, a few fossils are figured together in a separate division, because they are of a somewhat doubtful nature. They are also from the White Pine District, and came from beds known to hold a position between well-marked Carboniferous and Devonian rocks. All of them, excepting the *Spirifer*, came from a black bituminous shale, associated with some more or less arenaceous beds, beneath well marked Carboniferous limestones. The *Aviculopecten* (fig. 10) is very closely allied to some western Carboniferous forms; and the little shell represented by fig. 8 also resembles Carboniferous species believed to be at least nearly related to *Posidonomya*. The Brachiopod represented by fig. 9, however, is remarkably like Devonian species of *Leiorhynchus*, and hence would favor the opinion that this shale is Devonian. The *Spirifer* represented by fig. 11 seems to belong to the common and widely-distributed Carboniferous species *S. cuspidatus*, and came from a gray, subcrystalline, cherty limestone, above the above-mentioned black slate, and was associated with some large Crinoid columns, casts of an *Orthis*, like *O. resupinata* or *O. Michelini*, and imperfect specimens of a smaller *Spirifer*, apparently like the Devonian species *S.*

* These remarks on the Devonian age of the White Pine silver-bearing rocks were quoted by Mr. Arnold Hague, in the Mining Report of Mr. King's Survey, 416, (issued in 1870.) It is to be regretted, however, that, owing to the fact that Mr. Hague did not see the proof, several annoying typographical errors, in the names of the fossils mentioned, were not corrected.—F. B. M., Sept. 29, 1874.

† See Proceed. Acad. Nat. Sci. Philad., 1860, XII.

gregarius. The evidence to be drawn from these few fossils would therefore seem to be somewhat conflicting in regard to the exact age of these black shales and cherty limestones; but the first more probably belongs to the Devonian and the latter to the Carboniferous.

Of all the collections that have yet been brought from this region, the decidedly Carboniferous types are far more numerous than those from any of the other formations. This will be more readily understood when it is remembered that we have illustrated on the accompanying seventeen plates, all of the known species of every age of which there are specimens accessible, while the Carboniferous forms alone occupy plates 4, 5, 6, 7, 8, and 9, with the exception of one *Goniatite*, of apparently the same age, from New Mexico. These fossils consist almost exclusively of Corals and Brachiopods, and seem to have been obtained from two distinct rocks; that is, the Corals, with a few exceptions, together with an *Orthis*, a *Hemipronites*,* and *Productus semistriatus*, figured on plate 7, as well as a distorted specimen of *Productus punctatus*, and others of *Fusulina*, not in a condition to be figured, came from a dark-gray and deep bluish-gray limestone, while the other specimens came from a light yellowish-gray limestone. So far as has yet been ascertained from all of the explorers of Utah and Nevada, these two rocks have nowhere been observed to occur together at the same localities. That they belong to different horizons in the Carboniferous series of this region, however, seems to be evident, not only from their different lithological characters, but also from the fact that they contain mainly distinct groups of fossils. The specimens from the dark-colored beds came from Piñon and Diamond Mountains, Nevada, Long's and Boxelder Peaks, Strong's Knob, etc., Utah; while those from the light-colored beds are marked, north of Moleen Peak, Egan and Mahogany Ranges, Ruby Group, south of Railroad Cañon, White Pine Mountains, and various localities in the White Pine District.

From the fact that almost none of the peculiarly characteristic Coal-Measure species of the Mississippi Valley have been identified among the species from the dark-colored limestones mentioned above, while there are,

* Imperfect specimens of this species were also brought from the light-colored beds at Fossil Hill, White Pine.

among the specimens from that rock, fragments of an *Archimedes*, together with imperfect specimens of *Spiriferina spinosa*,* (both Lower Carboniferous types), it is very probable that this rock belongs to the Lower Carboniferous series. This view also receives some support from the presence, in these dark beds, of a species of *Lithostrotion*, a genus very abundantly represented by one or two species in the Lower Carboniferous, but unknown in the Coal-Measures of the Mississippi Valley.

When we turn our attention to the fossils from the light-yellowish Carboniferous limestones of Nevada, however, at the localities mentioned, we find among them forms undistinguishable from *Athyris subtilita*, *Spirifer cameratus*, *Productus Prattenianus*, and *Spiriferina Kentuckensis*;* none of which are certainly known from any horizon below the Coal-Measures of the Mississippi Valley. Hence it is more probable that these lighter-colored Carboniferous limestones belong to the horizon of the Coal-Measures; though I believe no beds of coal have yet been found associated with them.

Perhaps of all the collections of fossils that have yet come to us from the Far West, there are none more interesting than those from the Upper Trias of West Humboldt Range. The specimens from this formation in the collections under consideration are illustrated on plates 10 and 11, and will be seen to consist of a few bivalves and some ten or twelve species of *Cephalopoda*. The occurrence of this formation in that region was first made known by Prof. J. D. Whitney and Mr. Gabb, of the California Geological Survey, in the reports of which several of the species here figured were illustrated and described along with others.

It is a remarkable fact that there should be at these distant western localities an immense series of deposits, containing so exact a representation of the very peculiar fauna of the Upper Trias of Europe, as exhibited in the St. Cassian, Aussee, and Hallstadt deposits. For instance, there are, among the collections that have been by different parties found in these beds, the following peculiar genera, especially characteristic of the rocks of this age in Europe, viz., *Halobia*, *Monotis*, *Cassianella*,† *Trachyceras*, *Archestes*, *Clido-*

* The specimens of these species in the collection, although recognizable, are not in a condition to be figured.

† Mr. Gabb has described a species of this genus in the American Journal of Conchology from this formation in Nevada.

nites, etc., directly associated with the more ancient genus *Orthoceras*. There have also been found in these beds the following *species*, closely allied to, or possibly in some cases identical with, *Halobia Lommelei*, *Monotis Salinarius*, *Ceratites Haidingerii*, *Archestes Ausseanus*, etc. There are likewise known from this formation various other types of the *Ammonitidæ*, which, like those found at the same horizon in Europe, are not true Ammonites, nor Ceratites, nor yet Goniatites, as these genera have been restricted by late authors, but new generic types, sometimes intermediate in their characters between the typical forms of the above-mentioned genera.

It is evident, from the collections that have been already obtained from this formation, that a rich harvest of new and interesting forms awaits the collector who can visit this region under circumstances favorable to its thorough exploration.

The species in the collection believed to be of Jurassic age are illustrated on plate 12. The specimens of *Belemnites* came from the West Humboldt Range, Nevada; while all of the others were collected four or five hundred miles further eastward, at Weber Cañon, Wasatch Range, Utah, from apparently about the same horizon. It is barely possible that a few of the West Humboldt species that have been supposed to be of Triassic age may belong more properly to the Jurassic (Lias), as there seems to be a great development of these rocks there, without a strongly-marked division, so far as lithological characters are concerned, if we can judge by the matrix of the specimens. At any rate, the specimens of *Belemnites* from there are contained in an apparently undistinguishable matrix from that of the *Orthoceras* and other Triassic forms; while Mr. Gabb has described from that region an Ammonite (specimens of which I have seen in a similar matrix) that seems scarcely distinguishable from the European low Liassic species *A. bisulcatus*.

The species figured on the lower half of plate 12, from Weber Cañon, have been placed together in a separate division, because some doubts at one time existed in regard to the stratigraphical position of the bed from which they were obtained.*

* Since this was written and the plates arranged, Mr. King informs me that he has found this rock to be, as I had from the first believed, of Carboniferous age.—F. B. M., Nov. 29, 1874.

The Cretaceous fossils of the collection, as will be seen by plates 13, 14, and 15, are all merely casts of bivalves, excepting two species of *Gasteropoda*. Exclusive of the two species of large *Inoceramus*, represented by fig. 3 of plate 13, and fig. 4 of plate 14, which came from a different horizon near the eastern base of the Rocky Mountains, they are all from a light-yellowish sandstone, containing beds and seams of brown coal, at various localities in the region of Coalville and Bear River, Utah. The specimens yet obtained are in a bad state of preservation; but, as far as can be determined, they appear to be very nearly if not quite all distinct from the Cretaceous species yet known from the Upper Missouri country.

Taken collectively, this group of fossils presents much the general *facies* of the fauna of the series in California, referred by Professor Whitney to the upper part of the Cretaceous of that State, under the name Tejon Group. Yet, after careful comparisons with the figures and descriptions in the California reports, I am not fully satisfied that any of the species are positively the same; though in some instances they may at least safely be regarded as closely-allied representative forms. With the exception of the two or three species of *Inoceramus*, the genus *Gyrodes*, and perhaps *Anchura*, they present, so far as their characters can be made out from the specimens yet brought in, just such a group of forms as might be, with almost equal propriety, referred either to the Cretaceous or to the Tertiary.* The presence of the genera mentioned, however, would, in the present state of palæontological science, exclude them from the Tertiary and place them in the Cretaceous. The fact, too, that they are all marine types, while all of those yet collected in this great internal region of the continent, from well-defined Tertiary beds, are terrestrial, or fresh- and brackish-water types, would confirm the other evidence that these light-colored coal-bearing sandstones of the region of Coalville and Bear River really belong to the Cretaceous. Indeed, I arrived at this conclusion in 1860, while investigating Colonel Simpson's collections from this formation.† The fact, however, that all the collections yet brought in from this formation contain

* Since this was written, Dr. Hayden's party have also brought in, from these Coalville beds, other decidedly Cretaceous types of fossils.

† See Proceed. Acad. Nat. Sci. Philad., Ap. 1860, p. 126.

no *Ammonites*, *Scaphites*, *Baculites*, *Hamites*, *Turritiles*, *Helicoceras*, or any of the numerous other types generally believed to have died out at the close of the Cretaceous period (excepting the very few forms already mentioned), would appear to indicate that this formation was deposited at near the close of the physical conditions most favorable to the existence of types of life peculiar to the Cretaceous epoch; and hence that it belongs to some of the latest, if not to the latest, deposits of that period.*

The fossils from the Bear River fresh- or brackish-water strata, and those from later and undoubted Tertiary beds, have been illustrated together on plates 16 and 17. The species from these different horizons might more appropriately have been separated on distinct plates; but this could not well be done without arranging the figures on three plates; while there are not quite enough of them to be so distributed. Those from the oldest upheaved brackish-water beds associated with the light-colored marine Cretaceous sandstone already mentioned, at the Bear River locality, are *Unio priscus*, *U. belliplicatus*, and *Corbicula Durkeei* of plate 16; and *Corbula Engelmanni*, *C. pyriformis*, *Limnæa nitida*, *Rhytiphorus priscus*, *Campeoloma (Melantho) occidentalis?*, *C. macrospira*, *Viviparus Conradi*, and *Pyrgulifera humerosa* of plate 17.

This formation seems, at Bear River, to be associated with the Cretaceous sandstone of that region in such a manner as to give the impression that it probably immediately succeeded the latter in point of time. It is evident, however, from the striking contrast in the fossils characterizing the two formations, that marked physical changes had taken place here between the deposition of the last of the undoubted Cretaceous sandstones and the commencement of what appears to be the oldest Tertiary, since nearly or quite all the fossils found in the former are marine types, while those of the latter are fresh- and brackish-water, or, in some few instances, perhaps terrestrial forms. This strongly-marked change in the fossils in passing from the Cretaceous sandstone below into the fresh- and brackish-water beds apparently above, and the close affinities of most of the species in the latter

* Later personal examinations of these beds at Coalville, and the equivalent marine Cretaceous strata at Bear River, as stated in Dr. Hayden's Report of 1872, have satisfied me that this formation, at the former locality, represents probably nearly the whole of the Upper Missouri Cretaceous series.—F. B. M., Nov., 1874.

either to foreign Lower Tertiary species or to living forms, are the grounds upon which Dr. Engelmann and the writer, in 1860, referred these estuary-beds to the Lower Tertiary.

One of the species found in the Cretaceous sandstones at Coalville, Utah, certainly agrees very closely with *Corbula pyriformis* from the later estuary beds at Bear River, as may be seen by comparing fig. 2, plate 14, with fig. 2 *a*, plate 17. As the specimen from the sandstone, however, is a mere cast, it is not possible to make a very satisfactory comparison. It is also worthy of note here that there certainly is a species in the latest Cretaceous beds of California (*Corbula alaeformis* of Gabb) that agrees very nearly with our *C. pyriformis* from the Bear River estuary beds. Indeed, I find very little in the figure or description of the California species to distinguish it from some specimens of *C. pyriformis* var. *concentrica*. Most of the specimens of *C. pyriformis* are more coarsely and more irregularly ribbed and furrowed than is shown in Mr. Gabb's figure; but the specimens vary much in this character, some of them being nearly smooth, as in fig. 2 *a*, plate 17, while others are regularly ribbed, as in fig. 2, or irregularly so, as in fig. 2 *a*, and there are all conceivable intermediate gradations. As Mr. Gabb, however, only figures one specimen, it is not possible to make an entirely satisfactory comparison; though his species is most probably distinct from ours.

This similarity of a few of the forms in the upper coal-bearing Cretaceous beds in Utah, Wyoming, and California, with species in the estuary-beds in the Bear River country, and the general conformability of these formations, together with their association at the same localities, and the non-conformability of the estuary-beds with the later Tertiary, might suggest the inquiry, whether we ought not to carry up the line between the Tertiary and Cretaceous here, so as to include the estuary-deposits in the latter.

This suggestion would certainly appear to receive some support, from the fact that some of the vertebrate fossils collected by Dr. Hayden, apparently from equivalent estuary-beds at the mouth of Judith River, on the Upper Missouri, were regarded by Dr. Leidy as belonging to Cretaceous types. Supposing that the change from marine to fresh- and brackish-water

conditions in this region had taken place a little before, instead of exactly at, the close of the Cretaceous period, this change alone would be amply sufficient to account for the destruction of the marine Cretaceous forms. Still, this would not account for the paucity of strictly Cretaceous types here through a considerable thickness of marine sandstones below, nor for the striking Tertiary and more modern affinities of several of the forms in the estuary-beds above.*

While willing to admit that facts may yet be discovered showing that some of the brackish-water beds so widely distributed in this internal region of the continent belong more properly to the Cretaceous than to the Tertiary, I still think, from all the light we now have on the subject, that the Bear and Judith River fresh- and brackish-water deposits represent the oldest Eocene Lignites of the Paris basin. At least, if they are Cretaceous, there is little or nothing in the *molluscan* remains yet obtained from them to support such a conclusion. †

The probability is, as I have elsewhere remarked, that, as the continent was rising, toward the close of the Cretaceous epoch, the Rocky Mountains, in part at least, existed as islands in the Cretaceous Sea. Still later, as the process of elevation continued, considerable areas that had been occupied by the sea became at first partly isolated, so as to form bodies of brackish water, that gradually became fresh-water lakes, as further elevation completely isolated them from the influx of the sea. In the deposits formed in these waters, we might naturally expect to find, at the base, brackish-water types, and, further up, wholly fresh-water forms, just as is the case in the beds referred to the Tertiary in that region.

Whether this change from marine to fresh-water conditions was exactly contemporaneous with the close of the Cretaceous, and the introduction of the Tertiary epochs elsewhere, perhaps we shall never know; but that it

* For instance, compare *Corbicula Durkei* (fig. 6 a-g, plate 16) with *C. antiqua*, Ferrussac, and *C. Forbesii*, Deshayes, from the Lower Lignites of the Paris basin, as well as *Pyrgulifera humerosa* (figs. 19 and 19 a, plate 17) with the so-called *Melania armata* of Matheron, from the same horizon at the mouth of the Rhone.

† These remarks were written in 1870; since that time, however, additional facts have come to light, as already suggested, rather favoring the conclusion that these Bear River estuary-beds may belong to the latest Cretaceous.—F. B. M., Nov., 1874.

corresponded in the sequence of geological changes here to that event seems probable.

In the vicinity of Fort Bridger, Tertiary deposits exist, apparently of later date than the Bear River beds that have furnished the fossils mentioned above. So far as yet known, these Fort Bridger beds contain only fresh-water and perhaps terrestrial fossils. From this formation, the following species, figured on plate 17, were collected, mainly by Colonel Simpson's party, viz., *Limnæa similis*, *L. vetusta*, *Goniobasis Simpsoni*, *Planorbis spectabilis*, and *P. spectabilis*, var. *Utahensis*; also *Unio Haydeni*, figured on plate 16. So far as known, all the species from this formation are distinct from those found in the Bear River deposits; and only one species, *Planorbis spectabilis*, is very nearly related to any species found on the upper branches of the Missouri.

A few fossils in the collection, from the region of Fossil Hill, Kawsoh Mountains, Nevada, show that there is there an exceedingly interesting Tertiary formation. These fossils are in a beautiful state of preservation, and contained in a white, soft limestone, or indurated marl. Not a single one of the species yet known from this formation is identical with any of those hitherto discovered in any of the other Far-Western Tertiary deposits.* They are all fresh-water forms, and consist of the following species, viz., *Sphærium Idahoense* and *S. rugosum*, figured on plate 16, and *Carinifex Tryoni*, *C. Binneyi*, *Goniobasis sculptilis*, *G. subsculptilis*, and *Ancylus undulatus*, figured on plate 17. The species all being new, and the rock not having been seen connected with any of the other Tertiary formations of that region, we have no means of determining its exact position in the Tertiary series; though it is probably more recent than either of the other formations from which fossils are figured and described in this report. It will probably yield a large number of new and interesting fossils to whoever may be able to explore it thoroughly.

As it has been thought desirable to give as full and complete an

* At the time of writing the above, I had overlooked the possible identity of the species I have described under the name *Goniobasis sculptilis* with *Melania Taylora*, Gabb, described in vol. II, p. 13, Palæont. California, from apparently the same formation in Idaho.—F. B. M., Nov., 1874.

account as possible of the palæontology of the country explored, in a number of instances species have been figured and described even where the specimens are not in a condition to give any clew to their generic characters. - This has been done, because, notwithstanding the imperfection of the specimens, they can readily be identified as characteristic forms of the several respective rocks. Hence, as future explorers, under more favorable circumstances, obtain more extensive collections, it will certainly be found necessary in perhaps not a few instances, to modify the nomenclaturê here provisionally adopted. In all these doubtful cases, however, the doubts in regard to their generic or specific affinities have been fully indicated, either by the use of a query-mark or in words. In some other cases, fossils have been figured, and, as far as possible, described, where the species could not be certainly identified with known forms, nor yet satisfactorily determined to be new. In such instances, they are merely given as undetermined forms, without having any specific name appended.

In closing these remarks, I take pleasure in acknowledging my obligations to Professor Henry for the use of rooms, books, and specimens, as well as for other facilities at the Smithsonian Institution, while preparing this report.

SMITHSONIAN INSTITUTION,

Washington City, D. C., August 2, 1870.

DESCRIPTIONS OF FOSSILS.

SILURIAN SPECIES.

MOLLUSCA.

GASTEROPODA.

SOLARIIDÆ.

? Genus OPHILETA, Vanuxem.

OPHILETA COMPLANATA, *var. NANA*.

Plate 1, figs. 1, 1 a, 1 b.

Ophileta complanata, Vanuxem (1842), Report Third Geol. Dist. N. Y., 36, fig. 2.—
Hall (1847), Palæont. N. Y., I, pl. ii, fig. 2, and pl. iii, fig. 6.

Ophileta complanata *var. nana*, Meek (1870), Hayden's Prelim. Report of the U. S. Geol. Survey of the Territories, 295.

Shell compressed-planorbicular, both sides slightly concave; volutions about six, very narrow, and increasing very gradually in size, flattened and slightly oblique on the outer side, and presenting a quadrangular transverse section, with upper and lower surfaces somewhat converging inward from the angle on each side of the periphery.

Greatest diameter, 0.30 inch; thickness or height, 0.06 inch; diameter of last volution, measuring in the direction of the plane of the shell, 0.05 inch.

As Vanuxem's species was not fully described or well figured, it is scarcely possible to be positively sure that our shell might not be only a closely-allied species, without direct comparison with authentic examples

of the New York form. Our specimens are scarcely one-half as large as Vanuxem's figure; but we are not sure that they are entire. The shell, however, certainly agrees very closely with *O. complanata* in proportions and the exceedingly narrow character of its volutions. Still, as it seems to have nearly the same number of whorls in less than half the diameter of *O. complanata*, it may be a distinct smaller species. If so, it may be called *O. nana*.

Locality and position.—Ute Peak, south of Muddy Creek, a tributary of Bear River, Utah; from a gray, granular limestone of Lower Silurian age, and probably belonging to the epoch of the Calciferos Group of the New York series.

Genus RAPHISTOMA, Hall.

RAPHISTOMA ? ROTULIFORMIS, Meek.

Plate 1, figs. 2, 2 a, 2 b.

Euomphalus (*Raphistoma* ?) *rotuliformis*, Meek (1870), *Proceed. Acad. Nat. Sci. Philad.*, 61; and (1872) Hayden's *Ann. Rep. Geol. Survey of the Territories*, 464.

Shell small, sublenticular, or more than twice and a half as wide as high, with the periphery sharply angular, and the much-depressed spire a little more prominent than the convexity of the last turn below the angular periphery; umbilicus very wide, deep, and depressed-conical; volutions six or seven, exceedingly narrow, and increasing very gradually in size, all obliquely flattened, or sometimes slightly concave on the upper slope, which is nearly coincident with that of the spire, and with the under side sloping downward and inward (being nearly one-third wider than the upper surface) to the umbilicus, around which they are rather distinctly angular; aperture obliquely-rhombic. Surface unknown.

Breadth, 0.32 inch; height, 0.12 inch; breadth of last turn on the upper slope, 0.15 inch; on the under slope, 0.18 inch; breadth of aperture, 0.09 inch; height of aperture, 0.07 inch.

This species is evidently nearly allied to *Euomphalus polygyratus*, Roemer, from the Lower Silurian rocks of San Saba, Texas (see Kreid. von Texas, tab. xi, figs. 4 a, b). It differs, however, in being much smaller, its greatest diameter being less than one-fourth that of Roemer's species,

although it shows nearly the same number of volutions. Its volutions are also proportionally more convex below, and slope more abruptly into the umbilicus.

Locality and position.—Same as last.

RAPHISTOMA? TROCHISCUS, Meek.

Plate 1, figs. 3, 3 a, and 3 b.

Euomphalus (*Raphistoma*?) *trochiscus*, Meek (1870), Proceed. Acad. Nat. Sci. Philad., 61; and (1872) in Hayden's Ann. Rep. Geol. Survey of the Territories, 464.

Shell sublenticular, about twice and a half as wide as high; spire much depressed, or but little higher (measuring from the horizon of the sharply angular periphery) than the convexity of the last turn below the same; umbilicus wide, deep, and depressed-conical; volutions four and a half to five, increasing gradually in size, all obliquely flattened (or sometimes slightly concave) above, nearly on a line with the slope of the spire, and sloping downward and inward below to the umbilicus, into which the curve is so abrupt as to form an obtuse angle around its margin; aperture wider than high, and rhombic-subtrigonal in outline. Surface unknown.

Breadth, 0.40 inch; height, 0.15 inch; breadth of last turn, 0.12 inch; breadth of umbilicus, about 0.25 inch.

This is similar in general appearance to the last species, but may be readily distinguished by its less numerous whorls, which increase more rapidly in size. It is much more nearly allied to a form now before me in masses of chert, from the west side of Lake Pepin, in Minnesota, found in beds of about the age of the Calciferos sand-rock of the New York series. The latter, however, attains a much larger size; some of the specimens being an inch in diameter, with about six volutions. The Minnesota form is also more sharply angular on the periphery, and has the upper side of the volutions distinctly more concave, and the spire more depressed.*

Locality and position.—Same as last.

* In the Proceedings of the Philadelphia Academy for 1870, cited above (p. 62), I have proposed the name *E. Pepinensis* for this Minnesota species.

ARTICULATA.
CRUSTACEA.
PARADOXIDÆ.

Genus CONOCORYPHE, Corda.

CONOCORYPHE (PTYCHOPARIA) KINGII, Meek.

Plate 1, fig. 4.

Conocoryphe (*Conocephalites*) *Kingii*, Meek (1870), Proceed. Acad. Nat. Sci. Philad., 63.
Conocoryphe (*Ptychoparia*) *Kingii*, Meek (1872), Hayden's Ann. Report U. S. Geol. Survey of the Territories, 487.—White (1876), Palæont. of Lieut. Wheeler's Survey, 40, pl. ii, figs. 2 *a b, c*.

Entire form ovate and much depressed, with breadth equaling about two-thirds the whole length. Cephalic shield semicircular, or a little wider than long, with the anterior and antero-lateral borders regularly rounded in outline, and provided with a narrow, slightly-defined, marginal rim; posterior margin nearly straight, with the lateral angles terminating in abruptly-pointed extremities, so short as scarcely to project as far backward as the posterior margin of the second thoracic segment. Glabella depressed nearly even with the cheeks, about two-thirds as long as the entire head, and between one-third and one-fourth the breadth of the same behind, but narrowing forward to its subtruncated anterior end, and separated from the cheeks on each side and in front by a shallow furrow; occipital furrow moderately well defined, and continued as rather deep broad furrows along the posterior margins of the cheeks out nearly to the points where the facial sutures cut the margin; lateral furrows not clearly defined in the specimens, but apparently consisting of four pairs. Facial sutures directed at first, for a short distance, forward from the inner anterior end of each eye, then curving gracefully outward as they extend forward, until near the anterior margin of the head, where they are a little wider apart than the distance between the eyes, but again curving rather abruptly inward, so as to reach the anterior margin nearly on a line with each eye; posteriorly these sutures extend at first outward nearly at right angles to the longitudinal axis, from the posterior end of each eye, and then curve gracefully backward, so as to intersect

the posterior margin between one-fourth and one-third the distance from the lateral angles inward toward the glabella. Eyes rather depressed, slightly arched outward, separated from each other by a space somewhat less than half the entire breadth of the head, and placed less than their own length in advance of the posterior margin, and about once and a half their length behind the front margin of the head; visual surfaces narrow, and not showing any lenses under a good magnifier.

Thorax with its length bearing the proportions to that of the head of 79 to 52, and to its own breadth of 79 to 107, being very slightly wider near the middle than in front, and narrowing posteriorly, with gently convex lateral margins, from behind the middle to the pygidium. Axial lobe depressed, narrow, or only about two-thirds the breadth of each lateral lobe at its anterior end, and narrowing regularly with straight sides posteriorly; segments thirteen, nearly or quite straight, and each with some appearance of a small node or prominence at each end.* Lateral lobes depressed or nearly flat; pleuræ almost transverse, or arching slightly backward to near the extremities, which are abruptly pointed; each with a well-defined furrow, which commences small near the anterior inner end, and widens and deepens for about half-way out, and then narrows and becomes more shallow, so as to die out before reaching the lateral extremities.

Pygidium subsemicircular, being rounded posteriorly, with a narrow, slightly-flattened border, and somewhat rounded anterior lateral extremities; length bearing to that of the thorax the proportions of 30 to 79, and to that of the head of 30 to 52, with a breadth of not quite two-thirds that of the head; axial lobe equaling more than two-thirds the length, narrow, depressed, and showing more or less distinctly about five segments; lateral lobes much depressed, nearly twice as wide at the anterior end as the middle one, each with about three segments, which curve a little backward, and become obsolete before passing upon the narrow, smooth border; segments each provided with a comparatively large longitudinal furrow, corresponding to those on the pleuræ.

* In the specimens, these little prominences seem to be so very obscure as to leave doubts of their real existence as nodes. They are *much* too distinctly defined in our figure.

Entire surface apparently smooth, excepting fine radiating striæ on the anterior and lateral portions of the cephalic shield, that are scarcely visible without the aid of a magnifier.

Whole length, 1.60 inches; breadth of thorax, 1.07 inches; of cephalic shield (somewhat flattened by pressure), about 1.12 inches; length of thorax, 0.70 inch; length of pygidium, 0.30 inch; breadth of same, 0.60 inch.

Of this fine Trilobite, three entire specimens and a part of another were obtained. They are, however, all merely sharply-defined natural casts, formed by the deposition of a crust of arragonite in the original moulds left by the fossil in some kind of a matrix. The specimens were evidently somewhat flattened by pressure before or at the time they left their impressions in the rock. This compression has obscured the lateral furrows of the glabella; but most of the other characters of the upper side of the fossil are clearly seen, even to the facial sutures, and the faintly-marked radiating striæ around the front and lateral margins of the cheeks.

The genus *Conocephalites* (or more properly *Conocoryphe*, for a strict application of the rules of priority would, I should think, require that the latter name should be adopted for the genus to which they were both applied) is so nearly allied to *Olenus* that it may not be always easy to distinguish the two types without seeing the hypostoma, and hence it is possible that the form under consideration may be more properly an *Olenus*. As it has more the regular oval outline of the former, and less pointed and produced pleuræ than the latter, while it shows clearly the fine radiating striæ around the anterior and lateral margins of the head, so often seen in *Conocoryphe*, it more probably belongs to that genus. It is worthy of note, however, that all of the specimens seem to be much more depressed or flattened than any of the species yet described of that genus, while only one of them shows any traces of the slender ridge usually seen passing from the anterior end of each eye to the front extremity of the glabella; and in this one, the ridge is so faintly marked as to leave doubts whether or not it is natural.

The slight differences between some of the details of the type specimen illustrated on our plate, and those figured by Dr. White, are either sexual, or due to accidental causes. The most obvious of these differences

is the greater length of the posterior lateral spines of the cephalic shield in Dr. White's specimens, which difference is probably sexual; while the others seem to be mainly due to the accidental flattening of our specimen.

Locality and position.—Antelope Springs, House Range, Utah; Lower Silurian, and probably, judging from the known position of the genus *Conocephalites* in the rocks of this country and Europe, from the Primordial Zone.

Genus PARADOXIDES, Brongniart.

PARADOXIDES? NEVADENSIS, Meek.

Plate 1, fig. 5.

Paradoxides? Nevadensis, Meek (1870), Proceed. Acad. Nat. Sci. Philad., 62. *(See p. 28)*

The only specimen of this Trilobite obtained consists of a natural cast, formed by a moderately thick crust of arragonite, deposited in a natural mould, or impression, of a part of the thorax and the pygidium, with the free borders of the latter broken away. Its rather large size, much depressed form, spiniferous pleuræ, and general physiognomy, as far as seen, at once recall to the mind the well-known genus *Paradoxides*. A closer inspection, however, shows its pygidium to be proportionally larger than we see in the known species of that genus, with possibly the exception of *P. Forschhammeri* of Angelin.

Of the thorax, eight of the posterior segments are preserved. These show the axial lobe to be much depressed, and about as wide as the lateral ones, exclusive of the free recurved points of the pleuræ. The segments of the axial lobe are defined by a broad, rounded furrow, or depression, across the anterior side of each, and have much the general appearance of those of some species of *Paradoxides*, being a little thickened, squarely truncated, and slightly curved forward at the ends. But they differ in showing distinct remains of a mesial spine, or tubercle, on each, and in having an obscure, oblique furrow, or depression, on each side, passing outward and backward from the broad, anterior, transverse furrow to the posterior lateral angles, so as partly to isolate the slightly-thickened and truncated extremities of each. The lateral lobes are nearly flat, and composed of pleuræ that extend straight outward at right angles to the axis, to their free extremities, which are

abruptly contracted (almost entirely on the posterior side) into slender, rounded, very sharp spines, which curve backward and outward. Each of the pleuræ is also provided with a broad, rather deep, flattened furrow, which commences near the inner end, and extends straight outward for some distance, with parallel sides, but gradually tapers, mainly on the anterior side, to a lanceolate point, before reaching the free extremities. These furrows have not the obliquity usually seen in those of *Paradoxides*, but run parallel to the direction of the pleuræ, so as to leave a slender straight ridge of equal size along the anterior and posterior margin of each rib.

The pygidium, exclusive of the portions of the free border broken away, has a nearly semicircular outline, being about twice as wide as long, while it is as much flattened as the thorax. The part remaining equals in length the five thoracic segments next in advance of it. Its mesial lobe is much depressed, and about three-fourths as wide anteriorly as the breadth of that of the thorax at its widest part seen. Posteriorly it tapers moderately, and extends nearly the entire length of the pygidium, as seen with the free border broken away. It is evident, however, that the flattened border projected more or less behind its termination. It shows distinctly five segments, with indications of about two others at the posterior end. The lateral lobes have each three segments, the anterior one being extended out nearly parallel to those of the thorax, while the others are directed more obliquely backward, and rapidly widen outward. Like the pleuræ, they have each a broad, flattened furrow; that of the anterior one being nearly parallel to those of the pleuræ, while those of the other two are directed more obliquely backward, particularly the posterior one, which is almost parallel to the longitudinal axis of the body. These furrows are so deep and broad as to give the three segments of each lateral lobe the appearance of six irregular ridges; the irregularity being produced by the posterior two furrows, instead of passing along the middle of each segment, being curved backward so as to divide it very unequally, leaving the anterior part much the broader. No fine surface-markings are preserved on the specimen.

Entire length of the imperfect specimen, nearly 3 inches, of which the remaining 8 thoracic segments form 1.70 inches; breadth of the thorax, exclusive of the free spiniferous ends of the pleuræ, 2.05 inches, and, including

the projecting ends of the pleuræ, 2.40 inches; length of what remains of the pygidium, 1.03 inches; breadth of the same, about 1.80 inches.

Supposing it to be a true *Paradoxides*, with not less than sixteen thoracic segments, the entire specimen, when complete, could not have been far from six inches in length. It can hardly be a true *Paradoxides*, however.

It is possible I should call this species *Olenus* or *Parabolina Nevadensis*; but its large size seems to be an objection to placing it in any section of either of these groups. In the possession of a node, or spine, on each of the thoracic segments, as well as in the direction of the posterior segments of the lateral lobes of the pygidium, it agrees with the type of *Parabolina*; but, unfortunately, the specimen is not in a condition to show whether or not these segments of the pygidium terminated in produced marginal spines, while the furrows of its pleuræ have not the obliquity of those seen in that type, but agree more nearly with those of some species of *Conocoryphe*. The comparatively large size of its pygidium, and the nodes, or spines, on its thoracic segments, as well as the nature of the furrows of the pleuræ, are rather against its reference to *Paradoxides*, and lead me to think that it may belong to an undescribed genus; if so, it might be called *Olenoides*.

Locality and position.—Same as last.

DEVONIAN SPECIES.

RADIATA.

POLYPI.

FAVOSITIDÆ.

Genus ALVEOLITES, Lamarck.

ALVEOLITES MULTILAMELLA, Meek.

Plate 2, figs. 7, 7 a, and 7 b.

Corallum massive, apparently hemispherical, or subglobose. Calices very small, or uniformly only about three-hundredths of an inch in their greater diameter, and about half as much in their smaller diameter; as

seen in transverse sections, subtrigonal or subrhombic, and separated by walls equaling their smaller diameter in thickness; apparently not very oblique at their terminations to the general surface, and showing (at least in sections) a small tooth-like projection at the middle of the outer wall. Longitudinal sections showing the tabulæ to be numerous, extremely thin, and not always exactly transverse or parallel to each other, but nearly so, and arranged somewhat regularly at intervals of only one-hundredth of an inch apart. Mural pores comparatively rather large, and regularly arranged, so that six of them may be counted in a space of one-tenth of an inch.

In the size and form of its calices, as well as in its massive growth, this species is nearly allied to a coral described by the writer (under the name *A. vallorum*), found by Mr. Kennicott at "the Ramparts" on Mackenzie River, near Fort Good Hope, Arctic America (see Trans. Chicago Acad. Sci., I, 86, pl. xi, fig. 9). It differs, however, in having its calices slightly larger, and not ranging near so obliquely to the general surface; the tubes formed by their continuous growth being much straighter, and more nearly parallel with each other, or only slightly radiating, instead of being very oblique and curving about in all directions. Whether or not it agrees with the Arctic species in the arrangement of its numerous transverse septa or diaphragms and its mural pores, I have been unable to determine; these parts not having been seen in that coral.

Compared with European species, it seems to be in some respects allied to *A. suborbicularis*, Lamarck, from the Devonian rocks of France, and *A. reticulatus*, Steininger, from rocks of the same age in France and Germany. From the first, it differs in its massive instead of encrusting mode of growth, as well as in its thicker walls between the calices, which latter are also smaller; while its tabulæ are much more numerous and more crowded. Its calices are a size larger than those of *A. reticulatus*, and separated by thinner walls, they also seem to be less oblique.

Locality and position.—Argyle Hill, White Pine District, Nevada; Devonian.

ALVEOLITES (undt. sp.)

From near the same locality, there is, in the collection, from the Devo-

nian of the White Pine District, an imperfect specimen of an *Alveolites*, that grew in an irregular, rather thin, foliated form, with exceedingly oblique calices, of somewhat larger size and narrower form than the foregoing. This, I think, belongs to another species; but the specimen is scarcely in a condition to admit of its being figured and described.

Genus FAVOSITES, Lamarck.

FAVOSITES (undt. sp.).

Plate 1, fig. 6.

Corallum small, subglobose or ovoid, often growing attached to shells. Corallites rather small, and very unequal in size and form, in consequence of the rapid growth of young ones between the corners of the old, so as to give the latter a polygonal or nearly circular outline, while the much smaller young often appear at the surface with a trigonal or quadrangular form, all rapidly radiating in all directions. Tabulæ passing straight across at intervals nearly equaling the diameter of the larger corallites. (Septa and mural pores unknown.)

Diameter of corallum, about 1.50 inches; of the largest corallites, about 0.08 inch.

The specimens of this little coral have all the cavities solidly filled with silicious matter, so that it is scarcely possible to make out very clearly its more important specific characters. It may be a new species; but, in a genus like this, the species of which are often so difficult to distinguish, even from the very best preserved specimens, it would be folly to attempt to identify our coral with any of the known species, or to name and describe it as new, without better specimens for comparison.

Locality and position.—Three miles south of Piñon Pass, Piñon Range, Nevada; Lower Devonian or Upper Silurian. Found associated with *Spirifer Piñonensis*, *Atrypa reticularis*, *Edmondia?* *Piñonensis*, and fragments of a *Dalmanites*.

FAVOSITES POLYMORPHA, Goldf.?, var.

Plate 2, fig. 3.

Calamopora polymorpha, Goldf. (1826), Petrif. Germ., I, 79, tab. 27.*

Of this coral, I have seen but the single fragment figured, and this is

* For synonymy, see Edwards and Haime's Monograph of Fossil Corals.

not in a very good condition for examination. As nearly as its characters can be made out, it seems to belong to one of the varieties or species usually referred to *F. polymorpha* of Goldfuss. Without more and better specimens, however, it would scarcely be possible to determine its specific relations with exactness.

Locality and position.—Rio Verde, Arizona; found by Dr. Palmer associated with *Cyathophyllum Palmeri*.

Genus SYRINGOPORA, Goldfuss.

SYRINGOPORA (undt. sp.).

Corallites very slender or only about 0.06 inch in diameter; generally separated by spaces from one to three or four times their own diameter; usually nearly straight, but sometimes more or less flexuous; surface with small transverse wrinkles; connecting tubes distantly separated; (interior unknown).

In its general appearance, this coral rather closely resembles *S. perelegans*, Billings (Canadian Journal, March, 1859, fig. 19), and it may possibly belong to that species. As I only know it, however, from imperfect specimens, and there are doubtless many closely-allied species of this genus in the rocks of this country, I do not feel warranted in identifying it with that described by Mr. Billings, or in naming it as a new species. Its corallites are certainly more widely separated than in Mr. Billings's typical specimens, and, although this is to a considerable extent a variable character, I am rather inclined to regard it as a distinct species.

Locality and position.—Babylon Hill, White Pine Mining District; Devonian.

CYATHOPHYLLIDÆ.

Genus PTYCHOPHYLLUM, E. & H.

PTYCHOPHYLLUM? INFUNDIBULUM, Meek.

Plate 2, figs. 1, 1 a, 1 b.

Corallum subturbinate, or possibly becoming more or less cylindrical with age; central fossula moderately deep, truncato-obconic, about one-third the breadth of the entire corallum; rays stout, about fifty, generally

rather arcuate, or sometimes nearly straight along most of their length, every alternate one (or sometimes more) extending in nearly or quite to the middle, where they become tortuous, and apparently form a small, false columella; transverse plates stout, sometimes dividing, sloping a little from near the fossula to their free margins, which are subcrenate, while within they curve abruptly downward around the fossula. Transverse sections showing what appear to be a few dissepiments, arching strongly outward between the septa; but these may be oblique sections of the divisions of the infundebuliform plates. Vertical section showing a small prominence at the bottom of the central fossula, and under the fossula a few thin dissepiments passing transversely or curving a little upward as they approach what appears like a slender central columella.

Breadth, nearly two inches; height, somewhat less than one inch.

The specimens of this coral in the collection are very imperfect, and leave some doubts in regard to its true relations. Possibly I should call it *Chonophyllum infundibulum*, to which genus I was at first inclined to refer it. On making vertical sections of one of the specimens, however, I have found some appearances of a small, false columella. If these appearances are not deceptive, it would fall into the genus *Ptychophyllum*; but, if there was no columella, it would have to be referred to the genus *Chonophyllum*. Its septa, however, are much less numerous than those of any of the described species of the former genus; while it has also a smaller number than in any of the latter known to me, and likewise has a differently-formed calice.

Locality and position.—Treasure Hill, White Pine Mining District, Nevada; from the silver-bearing Devonian rocks of that region.

Genus DIPHYPHYLLUM, Lonsdale.

DIPHYPHYLLUM FASCICULUM, Meek.

Plate 2, figs. 4, 4 a, 4 b.

Corallum growing in tufts; corallites slender, elongated, cylindrical, moderately flexuous, and often adhering or growing together where brought into contact by the flexures, or sometimes by short, irregular, transverse processes; gemmation lateral; epitheca thin, and easily removed by weath-

ering, so as to expose the edges of the septa, thus presenting a distinctly striated appearance; surface more or less wrinkled transversely, but not very strongly so; septa from about thirty-six to forty, every alternate one of which is slightly thinner than the others, and generally terminates at, or a little within, the thin wall of the outer vesicular zone, while the others continue straight inward, and terminate abruptly a little before reaching the middle. Vertical section showing the narrow central space not occupied by the septa to be crossed by transverse plates, which seem to curve downward, and sometimes to divide all around the central transversely septate space, so as to form a kind of narrow, undefined inner vesicular area. Outside of this, there is a well-defined, very narrow, outer, vesicular zone, separated from the inner by a distinct, very thin wall, and occupied by only a single series of vesicles, the dissepiments between which range obliquely outward and upward. (Calices unknown.)

Entire size of corallum unknown; diameters of corallites, from 0.16 to 0.20 inch; spaces between the corallites rarely greater than the diameter of the latter, and generally less.

This coral seems to present essentially the structure of the genus *Diphyphyllum* of Lonsdale, particularly as illustrated by Professor McCoy in his figures of his *D. latiseptum* (Brit. Pal. Foss., pl. 3 c, fig. 10.) Specifically, however, it differs materially from that form in having more slender corallites, and a much narrower, outer, vesicular zone, as well as a proportionally wider middle area occupied by the broad tabulæ.

I am aware that Edwards and Haime have expressed the opinion, in their valuable Monograph of the Fossil Corals (p. 446), that the specimens on which Lonsdale's genus *Diphyphyllum* was founded, and those of another species described by McCoy, are probably only examples of *Lithostrotion*, in which the columella had accidentally been dissolved out during the process of fossilization. If this is so, the name of the species here under consideration would probably become *Diplophyllum fasciculum*, as it seems to present very nearly the structure of that genus as proposed by Professor Hall, who, however, has since expressed doubts whether or not his genus is distinct from *Diphyphyllum* of Lonsdale.

Whatever may be the real structure of Lonsdale's typical specimens of

Diphyphyllum, it seems to me that there can be no reasonable doubt in regard to the coral under consideration having no traces of a columella. It is true that fossil corals, in different states of preservation, sometimes do present quite deceptive appearances in their internal structure; but, from the examination of ground sections in various directions through the corallites, as well as from broken specimens, showing the interior more or less distinctly, I think I cannot be mistaken in the conclusion that this coral has not the characters of *Lithostrotion*, and agrees with Lonsdale's genus.

Locality and position.—Argyle and Treasure Hills, White Pine Mining District, Nevada; Devonian.

Genus ACERVULARIA, Schweigger.

ACERVULARIA PENTAGONA, Goldfuss (sp.).

Plate 2, figs. 5, 5 a.

Cyathophyllum pentagonum, Goldf. (1826), Petref. Germ., I, 60, tab. 19, fig. 3.—Morven (1832), Descr. Corall. Belg., 56.

Favastrea pentagona, de Blainville (1830), Dict. Sci. Nat., LX, 340; Mann. d'Actin., 375.

Astrea pentagona, Lonsdale (1840), Geol. Trans., 2d ser., V, pl. 57, fig. 1.—Phillips (1841), Palæozoic Fossils, II, pl. 6, fig. 15.

Acervularia pentagona, Michelin (1845), Icon., 180, pl. 49, fig. 1.—McCoy (1851), Brit. Palæozoic Foss., 19.—Edwards and Haime (1851), Polyp. Terr. Paléoz., 418; and Brit. Foss. Corals, 238, pl. 53, figs. 5, 5 a, 5 b.—Pictet, Traité de Paléont., pl. 108, fig. 3.—Milne-Edwards, Hist. des Corall., III, 410.

Acervularia ananas, Michelin (1845), Icon., pl. 47, fig. 1.

Lithostrotion pentagonum, d'Orbigny (1850), Prodr. de Paléont., I, 106.

Corallum astreiform. Corallites comparatively small, and of rather uniform size, generally hexagonal or pentagonal; septa eighteen to twenty-four, rather strong, nearly straight, half of them terminating at the inner wall, while the others continue in nearly to the center; outer walls very thin, minutely zigzag; inner walls moderately defined around the calices, which are of medium depth, and generally rather more than one-third as wide as the corallites. Dissepiments, as seen between the walls in vertical sections, very thin, rather closely arranged, and at some points slightly waved.

Entire breadth of corallum unknown; breadth of an imperfect mass of same, 2.80 inches; breadth of corallites, about 0.18 inch; breadth of calices, about 0.07 inch.

The specimen referred to the above species seems to agree well with the published figures and descriptions of that form. Its outer walls, as seen in transverse sections, are perhaps a little thinner, and its septa slightly more rigid or less curved, than represented in Edwards and Haime's enlarged figure of Goldfuss' species; but, unless better specimens than that I have seen might reveal some other characters than those observed, I cannot see how it can be separated from the European form.

It has much smaller corallites than any other species of the genus known to me from American rocks.

Locality and position.—Treasure Hill, Nevada; silver-bearing Devonian beds.

Genus SMITHIA, E. & H.

SMITHIA HENNAHII, Lonsdale (sp.).

Plate 2, fig. 6, 6 a.

- Astræa Hennahii* (pars), Lonsd. (1840), in Sedgwick and Murchison, Geol. Trans., 3d ser., V, 697, pl. 58, fig. 3.—Phillips (1841), Palæozoic Foss., 12, pl. 6, fig. 16.
Cyathophyllum Hennahii, Bronn (1848), Index Palæont., I, 368.
Lithostrotion Hennahii and *Actinocyathus Hennahii*, d'Orbigny (1850), Prodr. de Paléont., I, 106 and 107.
Phillipsastrea Hennahii (pars), d'Orbigny (1850), ib., 107.
Smithia Hennahii, Edwards and Haime (1851), Polyp. Foss. des Terr. Paléoz., 421; Brit. Foss., Corals, 240, pl. 54, fig. 4.—Edwards (1860), Hist. Corall., III, 413.
Arachnophyllum Hennahii, McCoy (1851), Brit. Palæoz. Foss., 72.
Acervularia seriaca, Quenstedt (1852), Handb. der Petref., 664, pl. 60, fig. 3.

Corallum apparently subhemispherical in general form. Mural circles from twice to about four times their own diameter apart, but irregularly arranged; as seen in a transverse section, moderately well defined. Septa twenty-three to twenty-six, very thin excepting near the mural circles, where they are somewhat thickened, and every alternate one terminates, while the others continue straight inward nearly to the center; all more extended, straighter, and more directly confluent in one direction (usually outward toward the periphery of the corallum) than transversely to the same; in which latter direction they are variously curved, or more or less abruptly geniculated. Vertical section showing the vesicular dissepiments between the septa to be very thin, nearly horizontal, and rather closely arranged.

Greatest transverse diameter of corallum, 4 inches or more; diameter of mural circles, about 0.10 inch; number of vesicular dissepiments seen between two of the septa, in a space of 0.10 inch of vertical section, 8.

It is possible that a very critical comparison of good specimens might show some differences in the details of structure by which this coral could be separated from the European *Smithia Hennahii*; but I have failed to detect any characters, either mentioned in the descriptions or illustrated in the most reliable published figures of that species, by which our specimens can be distinguished. Every word in Edwards and Haime's description of *S. Hennahii*, as they restrict the species, would apply equally well to the specimens under consideration, so far as their structure can be made out.

Locality and position.—Babylon Hill, White Pine Mining District, from the silver-bearing rock; Devonian.

Genus CYATHOPHYLLUM, Goldfuss.

CYATHOPHYLLUM PALMERI, Meek.

Plate 2, fig. 2.

Corallum composite, astreiform, growing in irregular masses three to four or more inches in diameter, with the corallites radiating in all directions from near the base of attachment. Corallites very unequal in size, and usually pentagonal or hexagonal in form, with rather deep calices in the middle; separated by nearly straight, moderately-projecting walls, excepting where a young corallite protrudes a little beyond the others, when it is sometimes surrounded by a nearly circular wall. Gemmation both calicular and interstitial; in the former case, the young corallites often growing up directly in the middle of the calices of the old, and soon expanding so as to take the place of the latter. Septa twenty-eight to thirty-four, well developed, slightly denticulated, thicker, and most prominent for about half-way inward, where every alternate one thins off to nothing, while the others continue on very thin to the center, where they form, without twisting, a small projection in the bottom of each calice. Vesicular dissepiments very thin, rather closely arranged, and not continued in farther than the ends of the shorter septa.

Breadth of the whole corallum, 4 or more inches; height, about 2.50

inches; breadth of the largest corallites, about 0.40 inch; but the average size not more than one-half to two-thirds as much.

At a first glance, this coral recalls such forms as *Cyathophyllum quadrigemmatum*, Goldfuss, as represented by figs. 6 *b* and 6 *c*, plate xviii, of his Petref. Germ. A moment's comparison, however, shows that it is very distinct. In the first place, its corallites are more compactly crowded together, and more strongly radiating, in consequence of the more rapid growth of intermediate young corallites, thus leaving no space for any of them to grow out free from the others. In a few instances, where a young corallite grew more rapidly than the others, it became free, and assumed a round or oval outline; but this form seems never to have been continued for more than very short distance before the rapid expansion of the young brought them into contact laterally, when they assumed angular outlines like the old ones, thus covered and hidden from view. The form of the calices in the species under consideration is also quite different, being very shallow or nearly flat for about half-way in from the walls, and then dropping in almost vertically; while, in *C. quadrigemmatum*, they slope abruptly inward from the walls. The latter likewise has about forty-six nearly equal septa to each corallite.

It is probably more nearly allied to *C. Sedgwicki*, Edwards and Haime (see British Foss. Corals, pl. lii, figs. 3, 3 *a*), but it differs in having constantly a smaller number of septa, which are all thicker at their outer ends, and taper inward, instead of being all thinner there, with the longer series becoming thickened about half-way in, and then thinning inward.

The young corallites growing up within the old often give the coral the appearance of an *Acervularia*; but a moment's examination shows that these inner circles are young corallites, and not inner walls.

The specific name is given in honor of Dr. E. Palmer, who discovered and brought in the only specimens I have ever seen. They are all silicified, so as to prevent the possibility of ascertaining the internal structure by sections of the corallites.

Locality and position.—Rio Verde, Arizona; from its affinities, it is believed to be of Devonian age.

MOLLUSCA.
BRACHIOPODA.
STROPHOMENIDÆ.

Genus HEMIPRONITES, Pander.

HEMIPRONITES CHEMUNGENSIS var. ARCTOSTRIATA, Conrad (sp.).

Plate 3, fig. 2.

Strophomena Chemungensis, Conrad (1843), Jour. Acad. Nat. Sci. Philad., VIII, 257, pl. 14, fig. 12.

Orthisina arctostriata, Hall (1861), Thirteenth Report Regents Univ. N. Y. on State Cab. N. H., 80; and (1862) Fifteenth do., 185 and 186, figs. 1 and 2.

Streptorhynchus arctostriatus, Hall (1863), Sixteenth Report Regents Univ. N. Y. on State Cab. N. H., 62.

Streptorhynchus Chemungensis var. *arctostriata*, Hall (1867), Palæont. N. Y., IV, 71.*

Shell small, nearly semicircular, rather depressed; hinge very nearly or quite equaling the greatest breadth; lateral extremities about rectangular; anterior and lateral margins forming together a semicircular curve. Ventral valve most convex at the beak, which is only moderately prominent, and a little distorted, but not arched, and seems in the figured specimen to have been broken at the apex in becoming detached from some body to which it had grown; area comparatively low, nearly flat, and very slightly inclined forward, or ranging nearly at right angles to the plane of the valves; pseudo-deltidium triangular and a little convex; surface marked by small radiating striæ. Dorsal valve unknown.

Length, 0.31 inch; breadth, 0.45 inch; convexity of ventral valve, 0.12 inch.

So far as can be determined from a single specimen of a ventral valve,

* Professor Hall's latest conclusion on this point is, that Conrad's *Strophomena Chemungensis*, published in 1843, includes, either as varieties or individual modifications of form, etc., all of the following proposed species, viz., *Strophomena bifurcata*, Hall, 1843; *S. arctostriata*, Hall, 1843; *S. pectinacea*, Hall, 1843; *Orthis perversa*, Hall, 1847; *Orthisina arctostriata*, Hall, 1860; *O. alternata*, Hall, 1860; and *Orthis inequalis* and *O. parvis*, Hall, 1858; as well as *Streptorhynchus pandora*, Billings, 1860. The names *S. pandora*, *S. arctostriata*, *S. perversa*, and *S. pectinacea*, he retains for varieties of Mr. Conrad's species (see Palæont. N. Y., IV, 67-73).

with the shell mostly exfoliated, this form seems to agree well with the above-cited New York species, as may be seen by comparing our figure with fig. 2, pl. 9, of the 4th vol. N. Y. Palæontology. It is quite possible, however, that a direct comparison with New York specimens might show it to be distinct. I do not feel justifiable, however, without a good series of specimens from the two distantly-separated localities for comparison, in running the risk of further complicating the synonymy of a species that has already received so many names, and consequently prefer to refer it to the New York species, instead of attempting to name it as new.

Locality and position.—Colonel Simpson's collection, latitude $39^{\circ} 30'$ N., longitude $115^{\circ} 36'$ W.; from dark Devonian limestone.

PRODUCTIDÆ.

Genus PRODUCTUS, Sowerby.

PRODUCTUS SUBACULEATUS, Murchison ?.

Plate 3, figs. 7, 7 a, 7 b.

Productus subaculeatus, Murchison (1840), Bull. Soc. Geol. Fr., XI, 255, pl. ii, fig. 9.—De Verneuil (in part) (1845), Geol. Russ. and the Ural Mts., II, 282, pl. xvi, fig. 9.—De Koninck (1847), Mém. Soc. Roy. Liège, IV, 249, pl. xiv, fig. 4; and Monogr. Prod. and Chon., 142, pl. xvi, fig. 4.—De Vern. (1847), Bull.—Soc. Géol. Fr., 2d ser., IV, 705, pl. lx.—Schnurr (1853), in Dunker and von Meyer's Palæont., II, 228, pl. xliii, fig. 4 a.—Davidson (1853), Quart. Jour. Geol. Soc., 336, pl. xv, fig. 12.—Sandberger (1855), Die Brach. Reinisch. Schicht. Nassau, 75, pl. xxxiv, fig. 17.—Davidson (1865), Monogr. Brit. Devon. Foss., 99, pl. xx, parts 1-2.—Meek (1876), Col. Simpson's Report Expl. across the Great Basin of Utah, 345, pl. i, figs. 3 a, b, c.

Leptæna fragaria, Sowerby (1840), Trans. Geol. Soc. Lond., 2 ser., V, 704, pl. lvi, fig. 5.—Phillips (1841), Pal. Foss., 59, pl. xxv, fig. 100.

Leptæna (Strophalosia) subaculeata, McCoy (1852), Brit. Pal. Foss., 388.

Comp. *P. Shumardianus* var. *pyxidatus*, Hall (1858), Iowa Report, I, part 2, 498 and 499.

Shell small, thin, truncato-subhemispherical; hinge equaling or less than the greatest breadth; ears small, nearly rectangular, or somewhat rounded; lateral margins rounding to the front, which is regularly rounded in outline. Ventral valve moderately convex, the greatest convexity being near the middle, without any traces of a mesial sinus; beak not very prominent, incurved, though without distinctly passing within the hinge-margin;

surface with small, obscure, concentric wrinkles and striæ of growth (strongest on the ears and sides of the umbonal region), and scattering spine-bases, apparently most numerous on the ears. Dorsal valve somewhat more than semicircular in outline, rather distinctly concave, the greatest concavity being in the central and anterior regions, marked with small, rather regular, concentric wrinkles and striæ of growth, with scattering pits corresponding to the positions of the spines of the other valve.

Length, 0.50 inch; breadth, 0.57 inch; convexity, 0.25 inch.

In regard to this little shell, I can only say that it seems to be so nearly like European forms referred by good authorities to *P. subaculeatus* that I have not been able, from the imperfect specimens yet brought in, to be quite sure that it is distinct. It is certainly nearly allied to that species, if not the same. As near as can be determined, however, from mere internal casts, it would seem not to have had such distinct tubercles at the bases of the spines as we see represented in most of the published figures of Murchison's species; though in this respect it appears not to differ from the Russian specimens referred by De Verneuil to *P. subaculeatus*. Still it differs from these and the specimens figured by others, in having more distinct concentric wrinkles, particularly on the dorsal valve. I expect it is probably only a representative species, but have not the necessary specimens to determine the question at present.

In general appearance, and the absence of any traces of longitudinal striæ, it resembles *P. pyxidatus* of Hall, but differs in being more convex, more symmetrical, and in having smaller ears and stronger concentric wrinkles, particularly on the dorsal valve.*

Locality and position.—From the dark, silver-bearing limestone, containing Devonian fossils, in White Pine District, Nevada. Colonel Simpson also brought specimens of it from the same rock at latitude 39° 30' N., longitude 115° 36' W., in 1860.

* Nothing short of a direct comparison of a good series of authentic European and American specimens can decidedly settle the exact relations of this shell to *P. subaculeatus*, as well as to several forms described by Professor Hall under the names *P. pyxidatus*, *P. Shumardianus*, *P. spinulocostatus*, *P. concentricus*, etc. Professor Hall seems now to think these probably all varieties of the one species *P. Shumardianus*; while European authorities most generally refer *all* such shells to *P. subaculeatus*.

RHYNCHONELLIDÆ.

? Genus ATRYPA, Dalman.

ATRYPA RETICULARIS, Linnæus (sp.).

Plate 1, figs. 7 and 7 a ; and Plate 3, figs. 6 ? and 6 a.

Anomites reticularis, Linnæus (1767), Syst. Nat., XII, ed., 1152.—Wahlenb. (1821), Nov. Act. Soc. Upsal., VIII, 65.

Terebratula pectinata, Bruguière (1789), Hist. Nat. Vers. Test. Encyc. Méth., 242, fig. 4.

Terebratulites priscus, Schlot. (1820), Petref., 262 ; Nacht., pl. xvii, fig. 2, and pl. xx, fig. 4.

Terebratulites explanatus, Schlot. (1820), Nacht., pl. xviii, fig. 2.

Terebratula affinis, Sowerby (1822), Min. Conch., IV, 324, fig. 2.

Atrypa reticularis, Dalman (1827), Vet. Akad. Verhandl., 127, pl. iv, fig.*

Of this widely-distributed form, there are numerous specimens in the collection from several localities, presenting all the characters of the species, with the limits usually assigned it. As it is too well known to require a detailed description, I would merely remark that the specimens from Piñon Station are larger and more robust than any of the others from the other localities, and closely resemble, not only in form and surface-markings, but in their state of preservation (being silicified), the numerous examples found in the Upper Helderberg limestones near Louisville, Kentucky. They were also found associated with a *Spirifer*, very closely allied to one of the Louisville species of that horizon.

The other specimens, from the silver-bearing, dark-colored limestone at Treasure Hill, White Pine District, and other localities, are all of smaller size, and not silicified. Some of these are finely striated, as represented by our fig. 6 a of plate 3, while others have the surface more coarsely striated or costated, as represented by fig. 6 of the same plate, and thus more nearly approach *A. aspera*, Schlotheim (sp.), to which possibly they might with more propriety be referred.† As there are, however, among the specimens

* For the long list of additional synonyms of this species, as most generally understood, see Mr. Davidson's Monograph British Silurian Brachiopoda, 130.

† Some reliable authorities believe that, even after separating *A. aspera* and some other forms often included as varieties, this name is made to include several distinct species. Never having made an especial study of the group, however, I have here included provisionally a few forms that a strict classification might possibly require should be separated under some of the published names.

intermediate gradations in this character, I have preferred to regard those showing this difference as more probably mere varieties of the variable species *reticularis*. The question in regard to the specific identity or difference of such shells is one respecting which authors may well differ without quarreling.

Locality and position.—Piñon Station, Treasure Hill, White Pine District; Roberts's Creek; and near Warm Springs, Upper Humboldt Range, Nevada. Colonel Simpson also brought specimens, including both the finely and more coarsely costated varieties, from latitude $39^{\circ} 30' N.$, longitude $115^{\circ} 26' W$

SPIRIFERIDÆ.

GENUS SPIRIFER, Sowerby.

SPIRIFER UTAHENSIS, Meek.

Plate 3, figs. 1, 1 a, 1 b, 1 c, 1 d, 1 e.

Spirifera Norwoodi, Meek (1860), Proceed. Acad. Nat. Sci. Philad., XII, 308 (not *S. Norwoodi*, Hall).

Spirifera Utahensis, Meek (1860), note appended to extra copies of above-cited paper.

Spirifera Utahensis, Meek (1876) in Col. Simpson's Report Expl. across the Great Basin of Utah, 345, pl. 1, figs. 4 a, b, c.

Shell rather small, very inequivalve, distinctly convex, or sometimes subpyramidal, with (as seen from above or below) its general outline forming rather more than a semicircle; length about one-half to two-thirds the greatest breadth; lateral extremities somewhat obtusely angular; anterior and antero-lateral margins forming together about a semicircular outline. Ventral valve elevated at the umbo, and sloping off abruptly to the front and lateral margins, with usually a slightly convex outline, especially on the anterior slope, sometimes with one of the lateral slopes concave in outline posteriorly; mesial sinus shallow, rather narrow, rounded within, and extended to the apex of the beak; beak elevated, abruptly pointed, and slightly arched; area high, or with height equaling about half its breadth, triangular, and continued to the extremities of the hinge, with well-defined or angular, lateral slopes, ranging at about right angles to the plane of the shell, and usually a little arched; foramen proportionally very narrow, or sometimes twice as high as wide. Dorsal valve much depressed, or but

moderately and evenly convex; beak very small, or little distinct from the cardinal margin, and somewhat incurved; area merely linear; mesial fold much depressed, being scarcely so defined as to correspond to the sinus of the other valve in size, and becoming nearly or quite obsolete before reaching the beak. Surface of each valve marked by about thirty to forty small, generally simple, radiating costæ, or striæ, about eight to ten of which occupy the mesial sinus, and about as many the mesial fold, where they sometimes bifurcate.

Length of a medium-sized specimen, measuring from the umbo of the ventral valve to the front, 0.57 inch; from the umbo of dorsal valve to the front, 0.49 inch; convexity of the two valves, 0.40 inch; breadth of a large specimen, 0.90 inch; length of ventral valve from beak to front, 0.77 inch; height of area, 0.38 inch.

This species is related to *S. Archiaci* of Murchison, from the Upper Devonian rocks of Russia, but differs in having the dorsal valve less convex and its mesial fold more depressed, while the foramen of its ventral valve is proportionally much narrower in all of our specimens. I have likewise been unable to see any traces of the fine surface-granulations observed on that species, though the specimens are scarcely in a condition to have preserved such fine surface-markings, if they ever existed. In general form, as well as in its high, large area, it has more the aspect of a *Cyrtia* or *Cyrtina* than of a *Trigonotreta*; but as none of the specimens show any indications of the foramen being closed by a false deltidium, or of a punctate structure, I have preferred to refer it provisionally to the typical section of the genus *Spirifer*.

Professor Hall and Mr. Whitfield have described, in the Twenty-third Report of the Regents on the New York State Cabinet, Natural History, 238, pl. 11, figs. 21-24, a species very similar to this, from the Hamilton Group of Iowa. Their figures represent their shell as having a somewhat higher and slightly less arch area, as well as a proportionally wider foramen; but, in nearly every other character, it certainly agrees very closely with the species here described.

Locality and position.—Longitude $115^{\circ} 26'$ W.; latitude $39^{\circ} 30'$ N., from a dark limestone of Devonian age; Colonel Simpson's collection.

Mr. Hague also found it with other Devonian fossils, at Fossil Hill, White Pine District, Nevada, in the silver-bearing Devonian beds; the formation being the same at these two localities.

SPIRIFER ENGELMANNI, Meek.

Plate 3, figs. 3, 3 *a*, 3 *b*, 3 *c* (and 3 *d*, 3 *e*, 3 *f*?).

Spirifera Engelmanni, Meek (1860), Proceed. Acad. Nat. Sci. Philad., XII, 308.

Spirifer Engelmanni, Meek (1876), Col. Simpson's Report Expl. across the Great Basin of Utah, 346, pl. 1, figs. 1 *a*, *b*, *c* (not *S. Engelmanni*, Meek and Worthen).

Shell rather small, somewhat gibbous, subsemicircular, or approaching subtrigonal in general form, with the greatest breadth on the hinge-line; lateral extremities rather acutely angular; anterior lateral margins with outline usually straightened and converging rapidly from the lateral extremities to the middle of the front. Ventral valve more convex than the other, its greatest prominence being at or near the beak, which is abruptly pointed and more or less incurved; area generally rather high, well defined, and standing nearly at right angles to the plane of the valves, but always arching backward with the beak; foramen higher than wide; mesial sinus narrow and shallow, but extending to the apex of the beak, smoothly rounded within, and bounded on each side by a plication that is a little more prominent than any of the others; lateral slopes each occupied by about seven to ten simple costæ. Dorsal valve moderately convex, the greatest convexity being near the middle; mesial fold narrow, flattened, or more or less rounded, and, like the sinus of the other valve, without costæ or plications; lateral slopes with costæ as in the other valve; beak scarcely distinct from the cardinal margin. Fine surface-markings and internal characters unknown. Figs. 3, 3 *a*, 3 *b*, and 3 *c* represent the type, while the others are only referred doubtfully to this species.

Length, 0.57 inch; breadth, about 0.82 inch; convexity, about 0.50 inch.

Specimens of this species with an elevated beak and area have much the general appearance of the last, and, when not well preserved, might be confounded with it by a careless observer. The two species, however, are very distinct, and may be readily separated by the larger costæ of the form under consideration, which also differs in never having any costæ occupying the mesial fold and sinus.

In naming a *Spirifer* after my friend Henry Engelmann, esq., in the Illinois Geological Report (vol. 3, p. 398), I had forgotten that the above-named species had been previously dedicated to the same gentleman. This renders it necessary to find another name for the Illinois species. I would therefore propose to designate it as *Spirifer Wortheni*.

Locality and position.—Same as last.

SPIRIFER (TRIGONOTRETA) ARGENTARIUS, Meek.

Plate 3, figs. 4, 4 a, and 4 b.

Shell rather small, moderately convex, wider than long, and having a general subsemicircular or subtrigonal outline, with the greatest breadth on the hinge-line; lateral extremities acutely angular; valves nearly equally convex. Ventral valve with the greatest convexity between the middle and the umbo; beak strongly incurved; area rather low, with nearly parallel sides near the break, but somewhat abruptly narrowed at the lateral extremities, though continued the entire length of the hinge; foramen wider than high; mesial sinus shallow and narrow, but well defined by the marginal rib on each side extending quite to the beak, and without costæ; lateral slopes each occupied by from twelve to fourteen simple radiating costæ, which diminish very gradually in size toward the lateral extremities. Dorsal valve most convex near the middle; beak rather distinctly incurved; mesial fold corresponding in size to the sinus of the other valve, being rather low, and flattened on top along its whole length, with a more or less defined furrow along its middle; lateral slopes costate, as in the other valve. Surface of both valves marked with very fine, regular, undulating lines of growth, most distinct between the costæ.

Length, 0.55 inch; breadth, 0.80 inch; convexity, 0.44 inch.

It is hardly possible that this can be a variety of the last; at least, with the means of comparison now available, it certainly seems to be quite distinct. It is true I have only two specimens of this form, but of the other we have a sufficient number of individuals, all agreeing with each other, and differing from this to such an extent as to render it very improbable that there may be connecting forms. On comparison, this species will be seen to differ very decidedly in having a *much* narrower (lower) and more

arcuate area, with nearly parallel margins. The beak of its ventral valve is also distinctly more incurved, as is that of its dorsal valve. It is likewise more nearly equivalve, has rather smaller and more numerous costæ, while its mesial fold differs in being depressed and furrowed along its top, instead of rounded.

Locality and position.—Treasure Hill, White Pine District, Nevada; from the dark Devonian limestone in which the White Pine Silver Mines occur.

SPIRIFER (TRIGONOTRETA) STRIGOSUS, Meek.

Plate 3, figs. 5, 5 a, 5 b.

Spirifera macra, Meek (1860), Proceed. Acad. Nat. Sci. Philad., XII, 309 (not Hall, 1856).

Spirifera strigosa, Meek (1860), to extra copies of the above cited paper.

Spirifer strigosus, Meek (1876), in Col. Simpson's Report Expl. across the Great Basin of Utah, 347., pl. 1, figs. 5, a, b, c, d.*

Shell rather under medium size, moderately convex, subtrigonal, or approaching subsemicircular, with the greatest breadth on the hinge-line; lateral extremities generally more or less acutely angular; lateral margins converging to the prominent, subangular middle of the front, with a somewhat straightened or convex outline. Dorsal valve convex in the middle, and compressed toward the lateral extremities; mesial fold narrow, rather prominent, and sometimes subangular near the front, continued to the beak. Ventral valve scarcely more convex than the dorsal, most gibbous in the umbonal region, with convex lateral slopes; beak moderately prominent, and distinctly incurved; area rather narrow, well defined, and narrowing off laterally, so as not quite to reach the extremities of the hinge, arched, and directed obliquely backward with the beak, rather distinctly striated vertically; mesial sinus corresponding in size to the fold of the other valve, the margins of both being usually a little produced in front, so as to impart an angularity to the outline of the middle of the anterior margin. Surface of each valve ornamented with from twenty to about twenty-six radiating costæ (counting at the free margins), some of which are simple, while others bifurcate. Of these costæ, about six or seven usually occupy the mesial fold and sinus. Two or three of those within each margin of

* I add references to Capt. Simpson's report here, in reading the proofs, that report having been published since the revision of this.

the sinus usually coalesce with the two marginal ones, which also generally each give off a lateral rib on the outer side; costæ of the mesial fold more or less bifurcating, while those of the lateral slopes of both valves are more frequently simple, but sometimes divided. (Finer surface-markings unknown.)

Length, 0.63 inch; breadth, 1.18 inch; convexity, 0.57 inch.

The type-specimens of this species were brought by Colonel Simpson's party, along with well-marked Devonian fossils, from near White Pine, Nevada. They evidently came from a dark, argillaceous limestone, exactly like that from which the Devonian types were obtained; yet the species so nearly resembles a form from a similar rock of the Carboniferous series farther eastward, that I have sometimes feared that possibly these specimens might have been found in the latter, and accidentally packed up along with the Devonian specimens. This suggestion receives at least some support from the fact that no such shell occurs among Mr. King's or any other collections I have yet seen from any of the Devonian rocks of the Far West. The Carboniferous shell alluded to above, resembling this species, I have been inclined to identify with *S. Rocky-montana*, of Marcou; but still it seems to shade off into forms even more nearly like *S. opimus*, such as that represented by fig. 6 on our plate 9.

On the other hand, however, there certainly are Devonian species very closely resembling that here under consideration; such, for instance, as *S. Orestes* of Hall and Whitfield, described from Devonian rocks in Iowa, regarded by those authors as most probably of the age of the Chemung Group of the New York series.* This Iowa shell so nearly resembles ours, especially when ventral views are compared, that I was at first inclined to believe them identical; but, on comparing the opposite view and profile, it will be seen that *S. Orestes* has its ventral beak more prominent and less incurved, and the cardinal area higher, with a broader fissure. Still shells much more unlike are regarded by high European authorities as being mere varieties of one species in some cases.

Locality and position.—Brought in along with Devonian fossils from a

* For figure and description of *S. Orestes*, see 23d Report of the Regents of the Univ. N. Y. on the State Cab. N. H., 237, pl. 11, figs. 16-20.

locality in Nevada, at latitude $39^{\circ} 32'$ N., longitude $115^{\circ} 36'$ W.; Colonel Simpson's collection.

SPIRIFER (TRIGONOTRETA) PIÑONENSIS, Meek.

Plate 1, figs. 9, 9 a, 9 b.

Spirifer (Trigonotreta) Piñonensis, Meek (1870), *Proceed. Acad. Nat. Sci. Philad.*, 60.

Shell attaining about a medium size, somewhat wider than long, varying from transversely-suboval to a nearly semicircular general outline, rather gibbous in adult examples; cardinal margin nearly or quite equaling the greatest breadth, and terminating in rectangular or rather more obtuse extremities; lateral margins rounding to the front, which is sometimes rounded, sometimes slightly sinuous, or in other examples more prominent and subangular in the middle. Ventral valve generally rather more gibbous than the other, its greatest convexity being in the umbonal region, from which it rounds off evenly toward the front and lateral margins as well as to the beak, which projects beyond that of the other valve, and is rather distinctly incurved; cardinal area of moderate height, narrowed to the lateral extremities, more or less inclined backward, and strongly arched with the beak; foramen having nearly the form of an equilateral triangle, and provided with slightly-raised, sharp, lateral margins; mesial sinus shallow, rounded, smooth, and of moderate breadth, narrowed regularly, and well defined to the apex of the beak. Dorsal valve generally more than semicircular, most convex in the central and anterior regions; beak projecting little beyond the cardinal margin, and with the narrow area incurved; mesial ridge depressed, smooth, and faintly furrowed along the middle, corresponding in outline to the form of the sinus in the other valve. Surface of each valve ornamented by from eleven to about fourteen simple, regular, rounded, radiating plications on each side of the mesial fold and sinus, and also showing, under a magnifier, minute, regular, crowded, radiating striæ, crossed near the front by stronger undulating lines of growth.

Length of a medium-sized specimen, 0.92 inch; breadth of the same, 1.20 inches; convexity, 0.72 inch.

This species seems to be more nearly related to *S. Oweni*, Hall, from the Upper Helderberg rocks at the Falls of the Ohio, than to any other known

to me. On comparison, however, with good specimens of that shell, from the original locality, it is found to differ in having a narrower area, which, with the beak of its ventral valve, is constantly more arched. Its plications are also larger and proportionally less numerous. There are in the collection large numbers of this shell in a good state of preservation, showing the characters mentioned to be quite constant.

Locality and position.—Three miles south of Piñon Pass, Piñon Range, Nevada; Devonian, probably of the age of the Upper Helderberg limestones of New York.

LAMELLIBRANCHIATA.

ANATINIDÆ.

Genus EDMONDIA, De Koninck.

EDMONDIA ? PIÑONENSIS, Meek.

Plate 1, figs. 8, 8 a.

Shell transversely-ovate, wider anteriorly than behind, rather gibbous in adult examples, most convex in the central and anterior central regions; anterior margin rounded from below the beaks into the base; posterior end narrow, most projecting near the base, where it seems to be very narrowly rounded in outline; dorsal border slightly highest a little behind the beaks, from near which point it slopes off more or less rapidly, with a convex outline, to the posterior basal extremity; beaks rather depressed, moderately convex, and placed about one-fourth the entire length of the valves behind the anterior margin; anterior muscular impressions shallow, elongate-sub-ovate, and placed near the margin, with its longer axis ranging nearly vertically; posterior so faintly marked as not to be apparent on internal casts. Surface of casts smooth, or only showing obscure traces of concentric marks of growth, with a shallow, narrow furrow, and some appearances of an obscure ridge, extending for a short distance obliquely upward and forward from near the posterior basal margin toward the umbones. Hinge unknown.

Length, 1.33 inches; height, 0.95 inch; convexity, about 0.60 inch.

At the same time that this species is here referred provisionally to the

genus *Edmondia*, I am by no means sure that I would not be nearer correct to call it *Palæoneilo Piñonensis*, since it has much the general appearance, and some indications of the oblique posterior basal sulcus, or slight concavity, of some species of the latter genus. Still, as it shows no traces of hinge-crenulations in any of the casts contained in the collection, while some of them seem to show some appearance of an impression near the hinge such as might have been made by a thin cartilage-process like that seen in each valve of *Edmondia*, I have concluded to place it, for the present, doubtfully in that genus. It may be found, however, when its generic characters can be made out from better specimens, to belong to an undescribed genus.

Locality and position.—Three miles south of Piñon Pass, Piñon Range, Central Nevada; from a limestone containing *Atrypa reticularis*, *Spirifer Piñonensis*, a small *Favosites*, and an *Avicula* or *Pterinea*, and believed to belong to the Lower Devonian.

CEPHALOPODA.

ORTHOCERATITIDÆ.

Genus ORTHOCERAS, Auct.

ORTHOCERAS KINGII, Meek.

Plate 2, fig. 8.

Shell attaining a rather large size, conical in general form, rather rapidly tapering; section circular or a little oval; septa numerous and closely arranged, the distance between being uniform, or very nearly so, without regard to the increase in the size of the shell from the smaller to the larger end; all deeply concave. (Surface and siphuncle unknown.)

Entire length unknown; length of a specimen imperfect at both ends and septate throughout, 5.25 inches; greatest diameter of same at the larger end, about 3.20 inches; of smaller end, 2 inches; distance between the septa throughout, 0.23 inch.

The specimen of this species is quite imperfect; but it seems desirable to call attention to it as one of the fossils characterizing the silver-bearing rocks of the White Pine District. It may be compared with such forms as

O. prosperum and *O. discors* of Barrande, though it tapers more gradually than either of these.

The specific name is given in honor of Clarence King, esq., the geologist in charge of the United States Geological Survey, by which the fossils here described were discovered.

ORTHOCERAS (undt. sp.).

Plate 2, fig. 9.

This is a mere fragment, consisting of a cast of most of the non-septate part of the shell. It shows scarcely any taper from the anterior to the posterior end, and presents a slightly oval section; while its rounded posterior end shows that the septa were rather deeply concave, and the siphuncle nearly or quite central. If new, it may be called *O. parallelum*.

Locality and position.—Babylon Hill, White Pine Mining District, Nevada; Devonian.

ARTICULATA.

CRUSTACEA.

PHACOPSIDÆ.

Genus DALMANITES, Auct.

DALMANITES (undt. sp.).

Plate 1, figs. 11 and 11 a.

Of this Trilobite, there are, in the collection, only a few imperfect moulds and casts of the pygidium. These show this part to have been subtrigonal in general form, with the posterior extremity rather acutely pointed, and extended, in some cases, even farther back than indicated by the dotted lines in fig. 11 a. It seems to be rather depressed, with the mesial lobe narrower than the lateral, and provided with about fifteen segments, with space enough at the posterior end for two or three more. The lateral lobes have each about thirteen segments, which extend out nearly at right angles from the mesial lobe anteriorly (excepting at their curved outer ends), and become gradually more oblique posteriorly. They extend nearly to the border, and only show the faintest traces of a mesial linear

furrow along some of the anterior ones. The surface is nearly smooth, or only has a few very small granules near the lateral margins.

I place this species along with the Devonian fossils only because it came from the same locality (and the specimens are in the same kind of matrix) as that from which the other forms, apparently of Devonian age, figured on the same plate, were obtained. In some of its characters, so far as known, it resembles Upper Silurian forms quite as much as, or even more than, Devonian; and, as Mr. King informs me that it came from the lowest bed at the locality, it may possibly belong to the Upper Silurian.

Locality.—Three miles south of Piñon Pass, Piñon Range, Nevada.

PROETIDÆ.

Genus PROETUS, Steininger.

PROETUS (PHÆTON) DENTICULATUS, Meek.

Plate 1, figs. 10, 10 *a*, and 10 *b*.

I have only seen fragments of this species, consisting of the pygidium, the glabella, and detached thoracic segments. As these parts have not been seen united, of course it is *possible* that they may belong to more than one type; and, to prevent confusion, if this should be found to be the case, the pygidium, represented by fig. 10 *a*, is regarded as belonging to the typical form of the species. From the manner in which these different parts occur associated together, however, it is quite probable that they all belong to the same species.

The pygidium is transversely subelliptic, and is nearly twice as wide as long, with a moderate convexity. Its mesial lobe is about as wide anteriorly as each lateral lobe (exclusive of their lateral spine-like projections), and more prominent than the latter, with three or four segments. The lateral lobes are rather depressed, and show about four segments each; these segments are not well defined, but have each a distinct mesial furrow, extending out to the margin, where each segment terminates in a short spine, directed backward; while there are two other smaller spine-like projections just behind the posterior end of the mesial lobe; thus making ten of these projecting points to the whole of the free posterior and lateral

margins. The surface shows a finely granular appearance under a magnifier.

The thoracic segments seen lying in the same fragment of rock indicate a rather distinct convexity for the thorax, with a rounded, moderately prominent, mesial lobe, about two-thirds as wide as the lateral lobes (see fig. 10 *b* of plate 1).

The glabella (fig. 10) found with the other specimens has a somewhat oblong outline, being longer than wide, with nearly parallel sides, and a more or less rounded anterior end; it shows two very faint lateral furrows on each side, and a strong neck-furrow passing entirely across behind. It retains the palpebral lobes on each side, and these indicate rather large eyes, of lunate form, and rather more than half as long as the glabella, exclusive of the neck-segment. They seem to have been located rather near the glabella on each side, and less than their own length in advance of the posterior margin of the cheeks. The surface appears to be rather more coarsely granular than that of the pygidium.

I know of no very closely allied species.

Locality and position.—The typical and only known specimens of this species were brought by Colonel Simpson from the west side of Steptoe Valley, Nevada; and, although not found associated with other fossils, they are believed to belong to the Devonian epoch.

CARBONIFEROUS SPECIES.

RADIATA.

POLYPI.

FAVOSITIDÆ.

Genus SYRINGOPORA, Goldfuss.

SYRINGOPORA (undt. sp.).

Plate 6, figs. 2, 2 *a*.

Corallites nearly parallel or moderately radiating, regularly arranged at distances of about once to nearly twice their own diameter apart, gener-

ally nearly straight or somewhat flexuous; connecting tubes of about half the diameter of the corallites, arranged in vertical rows, but usually alternating on opposite sides, separated by spaces varying from about once to twice the diameter of the corallites; epitheca thick and showing small wrinkles of growth; septa unknown; infundibuliform tabulæ, as seen in vertical sections, closely and regularly arranged.

Length of corallites unknown; diameter of same, 0.08 inch, separated from each other by spaces varying from 0.08 to 0.15 inch.

This species is related to *S. geniculata*, Phillips, and *S. ramulosa* and *reticulata* of Goldfuss, and may be a variety of one of these forms. After repeated very careful comparisons, however, with the published figures and descriptions of those species, I am left in doubt in regard to the propriety of referring it to either of them. Its corallites are slightly more slender than in *S. geniculata*, as represented by fig. 2, plate 46, of Edwards and Haime's Monograph of the British Fossil Corals, and decidedly less closely crowded together than represented by their fig. 2 *a* of the same plate. They agree almost exactly in size, however, with their fig. 4 of the plate cited, which they think probably represents a variety of *S. geniculata*. Still the connecting tubes are rather more closely arranged than in either of these figures, and the corallites are rather more widely separated. In the distances between its corallites, it agrees more nearly with *S. ramulosa*; but its corallites are a size smaller, and generally less flexuous. In the arrangement and general appearance of its tabulæ, as seen in vertical sections, it closely resembles Goldfuss' figure, but much less nearly that published by Edwards and Haime.

Compared with *S. reticulata*, its corallites are found to be a size larger, less closely arranged, and a little more flexuous, with more closely approximated connecting tubes. I suspect that it will be found to be a new species, or a marked variety of one of the above-mentioned forms, in either of which cases it might be called *S. occidentalis*.

Locality and position.—Southwest of Bald Mountain, Uinta Range, and at Morgan Peak, Wasatch Range, Utah; in a dark Carboniferous limestone.

CYATHOPHYLLIDÆ.

Genus ZAPHRENTIS, Rafinesque and Clifford.

ZAPHRENTIS EXCENTRICA, Meek.

Plate 4, figs. 1, 1 a, 1 b, 1 c, 1 d.

Corallum obliquely subturinate, moderately curved, very rapidly expanding. Calice apparently shallow, nearly circular, and (at least in the type-specimen) remarkably eccentric on the dorsal or convex side. Septa thin, straight or somewhat curved, about 160 in a specimen 2.50 inches in diameter; every alternate one continued some distance inward, but not reaching the middle, there being a rather broad, smooth, flat space left in the bottom of the calice; while those on each side of the fossula converge so as to intersect it before reaching the margin of the smooth central area; secondary series of septa extending but a short distance inward between the others; all of both series on the dorsal or convex side, as seen in weathered specimens, divaricating upward from a line along the middle on the exterior surface. Fossula well developed, and situated on the dorsal side, but extending inward to the margin of the flattened bottom of the calice. Outer vesicular area, as seen in a vertical section from the outer to the inner side of the curve through the fossula, comparatively narrow on the dorsal side, but very wide on the inner side, where it is occupied by numerous unequal, rather small, vesicles, ranging obliquely outward and upward within, but curving out horizontally, or even declining a little toward the exterior; tabulæ, as seen in the vertical section mentioned above, very thin, closely arranged, numerous, and passing horizontally across from the wide vesicular area, on the inner or concave side of the curve, nearly to the dorsal side, thus occupying more than half the entire breadth of the corallum; somewhat divided above, but becoming more simple, straighter, and much more crowded farther down.

Length of entire corallum, measuring along the outer side of the curve, about 5 inches; greatest diameter, 2.50 to 3 inches.

The only specimens of this species in the collection are so much weathered that the epitheca, and at places a portion of the outer vesicles, as well as the margins of the calice, have been removed. Sections of it, however,

both horizontal and vertical, show its internal structure very clearly. In its short, rapidly-expanding form, as well as in the divaricating arrangement of its septa along the middle of its dorsal side, and in the position of its fossula, it nearly resembles the form I have referred to *Z. multilamella*. From that species, however, it is readily distinguished by having its septa much more closely crowded, and particularly by having a very wide space within occupied by nearly straight, crowded tabulæ.

I know of no described species, either American or foreign, with which it is liable to be confounded.

Locality and position.—Boxelder Peak, Wasatch Range, Utah; Carboniferous limestone.

ZAPHRENTIS? MULTILAMELLA, Hall?.

Plate 6, figs. 4, 4a, 4b.

Zaphrentis? multilamella, Hall (1852), Stansbury's Report Explorations of Great Salt Lake Valley, 408, pl. i, fig. 2.

Corallum subturbinate, slightly curved, rapidly expanding; calice circular, of moderate depth; septa thin, about 150 to 160 in specimens measuring one and three-fourths to two inches in diameter, alternately longer and shorter, the latter extending one-third to one-half way inward, and the longer apparently reaching the middle of the calice; fossula narrow, deep, and extending inward from the convex side of the corallum nearly to the middle; outer vesicular zone apparently less than half the semi-diameter; vesicles somewhat elongated, and arranged obliquely outward and upward; those of the inner area formed by the complex nature of the tabulæ, arranged more or less obliquely upward and inward. Epitheca thin, and usually destroyed on weathered specimens, showing obscure septal costæ, with small wrinkles and low undulations of growth; costæ, and, in weathered specimens, the edges of the septa, divaricating upward at acute angles along an imaginary line up the middle of the convex side coincident with the fossula.

Length, measuring along the outer side of the curve, about 3 inches; breadth, 2 inches.

Professor Hall's figure of his *Z. multilamella* shows little more than its general form, and that it has a moderately deep calice; while his description

is so brief as to give but a very limited idea of the characters of the coral. It is therefore with considerable doubt that I refer the form under consideration to his species. The fact, however, that it came from the same formation and the same region of country, and possesses all of the few characters mentioned in his description, leads me to think that it may be the same. Still, in order to give those who may not have access to Stansbury's report the means of making the comparison for themselves, I quote below Professor Hall's description:

"Coral free, turbinate, somewhat rapidly expanding; cells deep; lamellæ numerous, thin; outer portion cellular."

He does not mention the *number* of septa (lamellæ); but from his statement that they are "numerous", and the fact that they are indicated at one point of the margin of the calice, in his figure, as being very closely arranged and thin, they may be as numerous as in our specimens. That from which his figure was drawn was split longitudinally very nearly through the middle, and apparently exactly coincident with one of the septa on each side, so as to show little or nothing of the structure within. It evidently had the margins of the calice less worn away than our specimens, which makes the cavity in ours look more shallow.

From the appearance of a false columella, or portuberance, in the bottom of the calice, I am not sure that this coral would not be more correctly called *Clisiophyllum multilamella*. If I am not mistaken, however, in its apparent possession of a septal fossula, it could hardly be properly placed in the genus *Clisiophyllum*.

Locality and position.—The typical specimens of *Z. multilamella* came from Cloth Cap and Flat Rock, Great Salt Lake. Those here referred to that species came from Strong's Knob, on an island in the Great Salt Lake, from a dark-colored Carboniferous limestone.

ZAPHRENTIS? STANSBURI, Hall?.

Plate 6, figs. 3, 3 a, 3 b, 3 c.

Zaphrentis Stansburii, Hall (1852), Stansbury's Report of Explorations Great Salt Lake Valley, 408, pl. i, figs. 3 a, b (not Marcou, N. Am. Geol., vii, fig. 7).

Corallum conical, slightly curved; epitheca thin, with moderately distinct septal costæ, and small, irregular wrinkles of growth; calice circular

or nearly so, rather deep, with steeply-sloping sides, and a somewhat irregularly-flattened bottom, showing some appearances, as seen in sections, of a low mesial prominence and other inequalities; septa very thin, about 150 in a specimen measuring one inch and a half in diameter, generally nearly straight, every alternate one terminating about half-way in, while most the others continue to the middle, where they are sometimes slightly bent. Outer vesicular zone occupying from one-third to one-half the space between the wall and the middle below the bottom of the calice, occupied by numerous vesicles, which, as seen in vertical sections, are generally very narrow, and more or less elongated, with their longer axes ranging obliquely upward and outward. Inner area occupied by numerous, somewhat larger, vesicles, which, as seen in vertical sections, have a general transverse arrangement, but arch upward all around a little within the lateral margins of the area, and then bend downward, and again upward as they approach the middle. Septal fossula, as seen in transverse sections below the bottom of the calice, narrow, and extending about one-half to three-fourths of the way inward from the side of the greater curve, as seen in fig. 3 b.

Length of the largest specimen seen, about 4 inches; greatest diameter of the calice, 1.80 inches; number of septa in one-tenth of an inch, at their outer ends, about 3 to $3\frac{1}{2}$.

It is only provisionally that I have referred this coral to the species described by Professor Hall. It certainly presents no characters inconsistent with his description, as far as that goes,* and agrees with his figure, excepting in having, in a larger specimen, nearly double the number of septa. This latter character, however, would separate it specifically, if the figure of *Z. Stansburii* is correct in that particular. It is certainly very distinct from the species referred, by Professor Marcou, to *Z. Stansburii*, in his North American Geology; the specimen there represented having only about sixty *thick* septa, not alternately shorter and longer. It will also be observed that Professor Marcou's figure likewise differs in this respect

* "Turbinate, free, or attached only by a pedicel, nearly straight, or but slightly curved; cup rather deep; margin (when entire) thin; lamellæ numerous, thin; intermediate ones extending from the margin one-third to one-half the semi-diameter; fossett distinct."—(Hall, Stansbury's Report.)

(though less decidedly so) from Professor Hall's, which certainly has the septa more crowded, thinner, and (as also stated in the description) alternately longer and shorter.

It will be seen from the description that this coral agrees rather closely in many of its characters with the last; so closely, indeed, that I have been much inclined to think it might be only a more slender variety of the same. Still, its longer, more attenuated form, and very nearly equally numerous septa, in rather decidedly smaller specimens, as well as the apparently different form of the bottom of its calice (see fig. 3 *c*,) and the direction of the vesicles formed by the complex tabulæ, if not deceptive, and constant, would certainly be of at least specific importance.

It is worthy of note, as already suggested with regard to the last, that longitudinal sections of both of these forms (but more particularly that of the last) show that the tabulæ curve upward so as to form a kind of false columella seen projecting upward in the middle of the bottom of the calice (see fig. 4 *b*), more nearly as in *Clisiophyllum* and *Lonsdalia* than I have ever yet observed in *Zaphrentis*. Still, they seem to differ from those types in the possession of a septal fossula, very clearly seen, at least in the species here under consideration; while neither of them presents a fasciculate, composite, or astreiform mode of growth, or shows any traces of well-defined inner walls, as in *Lonsdalia*.

I greatly regret having no opportunity to compare these and other far-western fossils with the original types of species briefly described, and not fully illustrated, many years back, in Frémont's, Stansbury's, and other Government reports; and can therefore only say that I have earnestly endeavored, to the best of my ability, to identify the described forms from the published figures and descriptions.

Locality and position.—Boxelder and Logan's Peaks, Wasatch Range, Utah, in a dark bluish-gray Carboniferous limestone. Professor Hall's specimens of *Z. Stansburii* came from the same horizon, on Stansbury's Island, Cloth Cap, and Flat Rock Point, Great Salt Lake. Dr. Hayden's party have also found this fossil quite abundant in the same kind of dark limestone on the divide between Ross Fork and Lincoln Valley, and at other localities in Idaho.

Genus CAMPOPHYLLUM, E. & H.

CAMPOPHYLLUM (undt. sp.).

Plate 5, figs. 2, 2 a, 2 b.

Corallum cylindrical, more or less elongated, nearly straight or somewhat curved, with ridges or irregularities of growth. Calice unknown; septa about eighty, very thin, every alternate one extending in about half-way to the middle, while the intermediate ones are much shorter; outer vesicular zone narrow, or only extending in about half as far as the longer costæ, occupied by numerous vesicles, which, as seen in vertical sections, range obliquely outward and upward; tabulæ thin, occupying a very wide space, passing horizontally across, but curving a little downward at their outer margins, and sometimes dividing and intersecting each other as they pass across. Epitheca thin, and, at least in weathered examples, marked by distinct septal costæ.

Length unknown; diameter, 1.60 inches.

The only specimen of this species I have seen is a fragment about five inches in length, and imperfect at both ends. It is much weathered, the epitheca being entirely removed, excepting on a few spots, and the calice broken away. I am somewhat inclined to believe that it may be the same species figured by Dr. Owen, from the Upper Coal-Measures on the Missouri River, under the name *Cyathophyllum vermiculare*, Goldfuss? (see plate iv, fig. 2, of his report of his Geological Survey of Iowa, Wisconsin, and Minnesota). The specimen is straighter than the Missouri River form usually is, and seems not to have had such strong wrinkles of growth; but it is so much weathered that the wrinkles might have been obliterated in that way. As nearly as can be determined by broken sections, both longitudinal and transverse, it seems to agree quite closely, in its internal structure, with specimens of the form figured by Dr. Owen, now before me from the original locality. In making the comparison, however, it should be understood that Dr. Owen's figures give no idea of the true appearance and number of the septa, or of the costæ.

The coral figured by Dr. Owen is a true *Campophyllum*, and, as he proposed to call it *Cyathophyllum torquium* in case it should be found to be distinct from Goldfuss' species, its name becomes *Campophyllum torquium*.

Fig. 1 of plate 5 represents another coral from the Carboniferous limestone of Piñon Mountains, with rather more closely arranged septa. It may be a *Zaphrentis* or a *Campophyllum*. Only undeterminable fragments of it have been seen.

Locality and position.—Diamond Range, near Newark; Carboniferous.

Genus LITHOSTROTION, Fleming.

LITHOSTROTION WHITNEYI, Meek.

Plate 6, figs. 1, 1 a, 1 b, 1 c.

Lithostrotion Whitneyi, Meek. (M. S.), White (1875), Palæont. of Lieut. Wheeler's Report, 103, pl. VI, figs. 1 a, b, c.

Corallum dendroid or growing in irregular, loosely-aggregated tufts. Corallites cylindrical, of unequal size, and separated by very unequal spaces, often widely divergent, and generally a little flexuous, sometimes slightly adherent where in contact; young branches rather strongly diverging from the larger at their origin, but soon curving so as to become more nearly parallel; epitheca well developed, and only showing faintly-marked septal costæ, and moderately distinct wrinkles of growth. Calices rather deep, nearly or quite circular, with a prominent, strongly-compressed columella rising in the middle; principal series of septa twenty-four to about thirty-three, extending inward, sometimes nearly to the columella, but often only as raised lines on the upper sides of the tabulæ along the inner half, though in other examples apparently becoming obsolete within, so as to leave a comparatively large space of the tabulæ smooth around the columella; secondary series of septa alternating with the others (with which they agree in number), and very short, or not extending inward beyond the very narrow outer vesicular zone. Outer zone well defined, and so narrow as to be occupied by scarcely more than a single series of small vesicles that range very obliquely outward and upward. Tabulæ of inner area very thin, rather closely arranged, and curving strongly upward around the columella, then extending at first nearly horizontally outward, and occasionally dividing as they slope or curve a little downward in approaching the outer zone.

Diameter of the largest corallites, 0.30 to 0.40 inch; of the smallest,

about 0.20 inch; number of costæ at the outer wall of one of the larger corallites, about six in 0.10 inch.

On first examining this coral, I was rather inclined to think it might be the same as a form described by me in the first volume of the California Report (plate 1, fig. 4) doubtfully as a variety of *L. mammillare*. On comparison, however, its corallites are found not only to be more irregular in size and more divergent, but to present important internal differences. In the first place, they have a more solid and well-defined columella, with the tabulæ of the inner area differently arranged. The most important difference, however, is to be observed in the comparative breadth of the outer vesicular zone, which is very much narrower in the species under consideration, and only occupied by one or two ranges of vesicles, instead of three or four; and these vesicles, as seen in longitudinal sections, are directed more obliquely upward (fig. 1 *c*, pl. 6).

Among the described European species, it seems to be most nearly represented by *L. Martini*, Edwards and Haime (see Brit. Mountain Limestone Corals, xl, figs. 2 *a-g*), and *L. Phillipsi*, E. & H. (ib., xxxix, figs. 3, 3 *a*). From the first of these, however, it differs not only in having the corallites less uniform in size, and often more divergent, but in having the tabulæ of its inner area, as seen in vertical sections, frequently divided instead of simple, and its outer vesicular zone proportionally narrower, while its secondary septa, as seen in transverse sections, and particularly in the calices, are proportionally shorter. It also differs from *L. Phillipsi* in the inequality and more irregular arrangement and greater divergence of its corallites, which are likewise less flexuous, and want the peculiar coalescent character so characteristic of that species. The *L. Phillipsi* probably also shows corresponding internal differences; but, as I have seen no figures or descriptions of its internal characters, I have no means of making farther comparisons.

The specific name of this coral is given in honor of Prof. J. D. Whitney, State geologist of California.

Locality and position.—From the dark bluish-gray Carboniferous limestone at Boxelder Peak, Wasatch Range, Utah.

Genus CYATHOPHYLLUM, Goldfuss.

CYATHOPHYLLUM (CAMPOPHYLLUM ?) NEVADENSE, Meek.

Plate 5, figs. 3, 3 a, 3 b.

Corallum attaining a rather large size, elongate-conical, and more or less curved; calice apparently circular, and very deep, with nearly vertical sides, and a flat bottom; septa about 100, every alternate one of which extends inward more than half-way to the middle, while those of the intermediate series extend in only one-third to one-half as far as the others; tabulæ very wide, somewhat irregular, and generally curving downward around their outer margins; outer vesicular zone, as seen in vertical sections, occupied by comparatively large vesicles, that range nearly vertically, or with only a slight outward inclination. (Surface unknown.)

Length of a weathered specimen not quite entire at either end (measuring around the outer side of the curve), 5.70 inches; diameter at larger end, about 2.30 inches.

The only specimen of this species in the collection is so much weathered that it retains none of the epitheca, while the margins of its calice are quite imperfect. Without seeing better specimens, it is difficult to determine whether it is a *Cyathophyllum*, a *Campophyllum*, or a *Zaphrentis*. The transverse section (fig. 3 b) seems to show some indications of a fossula in the arrangement of the septa, as represented in the upper part of the figure. If this is really a fossula, the species may have to be called *Zaphrentis Nevadensis*.

Locality and position.—Boxelder Peak, Wasatch Range, Utah; Carboniferous.

CYATHOPHYLLUM SUBCÆSPITOSUM, Meek.

Plate 5, figs. 4, 4 a, 4 b.

Corallum subfasciculate, with gemmation lateral; corallites few, the young starting by slender stems rather low on the sides of the old, and growing up more or less nearly parallel with the latter, but apparently without again uniting or branching above, where they soon nearly or quite equal the size of the old; all subcylindrical above their tapering bases, and more or less flexuous, with a few swellings and smaller wrinkles of growth; epitheca of moderate thickness, and scarcely showing septal costæ.

Septa from about fifty-six to seventy, all very thin in the outer vesicular zone, but (as seen in transverse sections) with the principal series thicker within, and continued nearly (or apparently in part) quite to the middle, while those of the intermediate shorter ones do not extend inward beyond the narrow vesicular zone; vertical sections showing the vesicular zone to extend only from one-fourth to one-third of the way to the middle, and to be occupied by a few rows of unequal vesicles, ranging outward and upward. Tabulæ, as seen in the section last above mentioned, numerous, occupying a very wide space, equaling more than two-thirds of the entire breadth of the corallum, passing nearly straight across, or merely curving downward a little at their lateral margins, somewhat irregularly arranged, and, in part, more or less divided.

Entire length of corallites unknown; diameter of largest seen, 0.62 inch.

One of the most marked features of this coral is the great breadth of the tabulæ compared with the narrow, outer, vesicular zone. This character, and the fact that in some transversely-broken sections the septa do not reach the middle, at first caused me to suspect that it might be a branching *Campophyllum*. It is true, the species of that genus hitherto known are simple; but, as suggested by Edwards and Haime, there may be branching species yet unknown. On grinding a transverse section, however, I find that the larger septa all extend farther inward than is usual in *Campophyllum*, while some of them seem to extend quite inward to the center (see fig. 4 a). I am therefore led to refer it to the genus *Cyathophyllum*.

Specifically, it does not appear, when all its characters are taken into consideration, to be nearly allied to any of the described species with which I am acquainted. In the size of its corallites, and apparently in their mode of growth, as well as in the great breadth of its tabulæ, it is very similar to *C. pseudo-vermiculare* of McCoy (Brit. Pal. Foss., pl. 3 c, fig. 8); but it has a much larger number of septa, which pass farther inward, while its outer vesicular zone is decidedly more complex.

Locality and position.—Near Swansea, White Pine District; Carboniferous.

MOLLUSCA.
BRACHIOPODA.
STROPHOMENIDÆ.

Genus HEMIPRONITES, Pander.

HEMIPRONITES CRENISTRIA, Phillips (sp.).

Plate 7, fig. 2.

- Spirifer crenistria*, Phillips (1836), Geol. Yorks., II, 216, pl. ix, fig. 6.
Spirifer senilis, Phillips (1836), ib., fig. 5.
Leptaena anomala, Sowerby (1840), Min. Conch., VII, 9, pl. 615, fig. 1 *b* (not 1 *a*, *d*, *c*).
Orthis umbraculum, Portlock (1843), Geol. Lond., 456, pl. 37, fig. 5.—De Koninck (1843),
 An. Foss. Carb. Belg., 222, pl. xiii, figs. 4–7 (not von Buch).
Orthis Bechei, McCoy (1844), Synop. Carb. Foss. Ireland, pl. xxii, fig. 3.
Orthis comata, McCoy (1844), ib., fig. 5.
Orthis caduca, McCoy (1844), ib., fig. 6.
Orthotetes radians, Fischer (1850), Bull. Soc. Imp. Mosc., XXIII, pl. 9, fig. 3.*
Leptaena crenistria, McCoy (1855), Brit. Pal. Foss., 450.
Leptaena senilis, McCoy (1855), ib., 452.
 ? *Orthis Keokuk*, Hall (1858), Iowa Report, I, part ii, 640, pl. xix, figs. 5 *a*, *b*.
 ? *Orthis robusta*, Hall (1858), ib., 713, pl. xxviii, figs. 5, *a*, *b*, *c*.
Streptorhynchus crenistria, Davidson (1860), Mon. Scottish Carb. Brach., 32, pl. i,
 figs. 16–22; and in Mon. Brit. Carb. Brach. (1861), 124, pl. xxvi, fig. 1, pl.
 xxvi, figs. 1–5, and pl. xxx, figs. 14–16.
 ? *Streptorhynchus Hallianus* and *S. Tapajotensis*, Derby (1874), Bull. Cornell Univ., I,
 35 and 37, pl. v.

The specimens that I have here referred to the above-named widely-distributed and well-known species, seem to agree in all their external characters with the published figures and descriptions of that form as given by the most reliable European authorities. None of them, however, show the interior, and they are all in a bad state of preservation.

Locality and position.—Light-colored limestone, Fossil Hill, White Pine District; White Pine County, twenty-five miles northeast of Hamilton; and Railroad Cañon, Diamond Mountains. The specimen figured was brought by Colonel Simpson from a dark limestone near Camp Floyd. All Carboniferous.

* The name *Orthotetes* was first proposed by Fischer in 1829; but as he neither then, nor at any subsequent time, named, described, figured, or cited any type (until 1850), his genus cannot be regarded as antedating *Hemipronites*, Pander, 1830.

Genus ORTHIS, Dalman.

ORTHIS MICHELINI, L'Eveillé, var.

Plate 7, figs. 1, 1 a, 1 b, 1 c.

- Terebratula Michelini*, L'Eveillé (1835), Mém. Soc. Géol. France, II, 39, pl. ii, figs. 14-17.
Orthis Michelini, De Koninck (1843), An. Foss. Carb. Belg., 228, pl. xiii, figs. 8 and 10 c, d.—De Verneuil and De Keyserling (1845), Géol. Russ., II, 185, pl. xii, fig. 7.—Semenow (1854), Foss. Schles. Kolenk., tab. iii, fig. 11.—McCoy (1854), Brit. Pal. Foss., 448, tab. iii, fig. 11.—Davidson (1860), Scottish Carb. Brach., 30, pl. i, figs. 7-10; and again (1861), Brit. Carb. Brach., 132, pl. xxx, figs. 6-12.
Terebratula filiaris, Phillips (1836), Geol. Yorks., II, 220, pl. xi, fig. 3.
Orthis divaricata, McCoy (1854), Synop. Carb. Foss. Ireland, pl. xx, fig. 17.
Orthis circularis, McCoy (1854), ib., fig. 17.
Orthis Michelini var. *Burlingtonensis*, Hall (1858), Iowa Report, I, part ii, 596, pl. xii, fig. 4.
 Compare *Orthis Penniana*, Derby (1874), Bulletin Cornell University, I, No. 2, 26.

Shell rather gibbous, both valves being convex, but the ventral less so than the dorsal, longitudinally oblong or subquadrate in outline, with breadth nearly as great posteriorly as in front; lateral margins nearly straight and parallel, anterior lateral rounding more or less abruptly into the front, which is rounded, somewhat straightened, or very faintly sinuous near the middle; hinge-line very short, or less than one-third the breadth of the valves. Dorsal valve distinctly and generally evenly convex; beak slightly prominent, and only a little incurved; area small, very moderately arched. Ventral valve moderately convex all over, excepting near the front, where it is depressed so as to form a broad, shallow, undefined, mesial sinus; beak projecting little beyond that of the other valve, and arched but not strongly incurved; area very small, well defined, inclined, and arching more or less backward; foramen moderate, but nearly or quite closed by the cardinal process of the other valve. Surface of both valves ornamented by numerous, crowded, even, more or less dichotomous, radiating striæ, that arch outward on the posterior lateral regions, and are crossed toward the front and lateral margins by rather distinct marks of growth. (Internal characters unknown.)

Length of largest specimen seen, 1.54 inches; breadth, 1.32 inches; convexity, 0.95 inch.

I have long been much perplexed in regard to the proper disposition

of this shell. It has much the general aspect of *O. Michelini*, but differs rather decidedly from any authentic variety of that species figured in foreign works in its longitudinally oblong outline, straight and parallel lateral margins, and greater convexity, especially that of its ventral valve, which in *O. Michelini* is most generally flat, or even a little concave, around the anterior region. Its area is also proportionally smaller than in *O. Michelini*. In some respects, it agrees more nearly with a South American form described by Professor Derby under the name *O. Penniana*, already cited. Still, it differs quite strongly in its oblong or quadrate form (produced by the straightness and parallel outline of its lateral margins, which cause the breadth of its valves to be almost exactly as great posteriorly as toward the front); while *O. Penniana* is decidedly wider anteriorly than behind, almost exactly as in the typical form of *Michelini*. If *O. Penniana* of Derby is really specifically distinct from *O. Michelini*, which I am rather inclined to doubt, then our shell might with more propriety be arranged as a variety of the same than of *O. Michelini*, unless it may present some internal differences. If distinct from the above-mentioned forms, either specifically or as a variety, it may be designated by the name *Nevadensis*.

Locality and position.—From the Carboniferous limestones of White Pine County, Nevada, twenty-five miles east of Hamilton, on the Egan Road; also, at Railroad Cañon, Diamond Mountains. Colonel Simpson also brought it from the pass between Desert and Pleasant Valleys.

PRODUCTIDÆ.

Genus *PRODUCTUS*, Sowerby.

PRODUCTUS NEVADENSIS, Meek.

Plate 8, figs. 2, 2 a, 2 b, 2 c, 2 d, 2 e.

Shell of medium size, with a general elongate-subovate form, as seen in adult examples, which are much produced anteriorly; hinge less than the greatest breadth. Ventral valve very gibbous, strongly arched, the curve regularly increasing from the produced front to the beak, provided with a rather deep mesial sinus, which extends from near the beak to the front; gibbous central region comparatively narrow, and, on each side of the sinus, rounded and falling off laterally very abruptly, especially to the ears; beak

rather narrow, distinctly incurved, so as to pass within the hinge-line; ears small, nearly rectangular; lateral margins sometimes faintly sinuous near the ears, and rounded to the front, which is rounded or a little sinuous in outline at the middle, as seen from above; surface ornamented by rather broad, regularly-arranged, concentric undulations, which become obsolete on the umbonal region, and more strongly defined and wider anteriorly, while on the umbonal portion there are numerous minute, slightly-elongated prominences, arranged in quincunx, which probably bore minute spines; farther forward the little spine-bases are arranged in concentric bands, mainly in the furrows between the concentric undulations; spines apparently all small, short, and inclined forward, or more or less depressed; interior with the scars of the cardinal muscles narrow, nearly parallel, deeply striated, and very profoundly impressed, so as to form on internal casts two very prominent, parallel ridges, between which are seen the distinctly-corrugated scars of the adductor muscles. Dorsal valve flattened, concave over the whole visceral region, excepting a slight mesial ridge corresponding to the sinus of the other valve, and marked by numerous small, regular, concentric wrinkles, with many little projecting points that seem to have borne small spines, especially toward the anterior and lateral margins. Interior unknown.

Length of one of the largest specimens, measuring over the curve of the ventral valve from the beak to the front, 4.30 inches; breadth, 1.76 inches; convexity, 1.30 inches.

For about ten years past I have, at different times, had under consideration specimens of this *Productus*, without being able to identify it with any of the described species. I have had no difficulty in separating it from all of other known forms from the Far-West, and have always found it to be quite constant in its characters. In young examples, it is much like *P. Nebrascensis* of Owen;* though in adult specimens, it is found not only to attain a much larger size, but to be proportionally greatly more produced in front, as well as much more gibbous; while it evidently did not possess

* Not as represented by Dr. Owen's figure given under that name, on plate v of his Wisconsin, Iowa, and Minnesota Report, however, which figure certainly does not represent the species *described* under that name by Dr. Owen, as may be seen by reading his description, and as I know from examining his type-specimens.

two sets of spines as in the *P. Nebrascensis*, on which the larger spines were long, strong, and erect. On Dr. Owen's species, the little tubercles, or prominences supporting the spines, are also so much elongated as often almost to present the appearance of little costæ (especially on internal casts broken from a limestone matrix), which is not the case with the species under consideration. I have now before me many specimens of *P. Nebrascensis*, some of which were collected from the original locality, in Nebraska, while others came from the same horizon in Kansas, Iowa, and Illinois, and none of these attain more than half the size of the species here described, nor are any of them but slightly more than hemispherical; while they are all proportionally broader across the umbonal region of the ventral valve. In no instance have I ever seen a specimen of that species so greatly produced in front as we see in this. The most marked differences, however, are to be observed in the internal casts of these two shells, that of *P. Nebrascensis* scarcely showing any traces of the muscular scars.

Among foreign species, our shell is perhaps most nearly represented by some of the narrow, elongated varieties of *P. scabriculus*, *P. pustulosus*, or *P. punctatus*; but it seems to me to differ too decidedly and constantly from these to render any detailed comparison necessary. Nevertheless, I expect to see it (as is too often hastily done in similar cases) arranged by some authorities as a synonym of one, or alternately of each, of the above-mentioned species. I am aware that our fig. 2 *b*, for instance, presents much the appearance of some varieties of *P. punctatus*, because it is not placed in a posture to show the greatly-produced anterior, as shown in fig. 2 *e*, nor the strong distant concentric ridges as seen in fig. 2. These, however, are not the only differences; for our shell is *constantly* much narrower than the usual form of *P. punctatus*, while its umbonal region has a much more squarish appearance, if I may so term it, owing to the sudden and vertical descent of its sides to the ears. Again, it will be seen to present strongly-marked differences in the form and relative sizes of the muscular scars in the ventral valve, by comparing our fig. 2 *c* with fig. 17 of plate xlv of Mr. Davidson's Monograph of the British Carboniferous Brachiopoda. Equally good distinguishing characters can be pointed out between it and the other species mentioned.

Locality and position.—West side of Buell Valley; Summit Spring Pass; Ruby Valley; White Pine Mountains and other localities in Nevada: from a light-colored limestone believed to belong to the upper part of the Carboniferous series of that region.

PRODUCTUS (undt. sp.)

Plate 7, figs. 6, 6 a, 6 b.

Compare *Productus Ivesii*, Newberry (1861), Ives' Report on the Colorado, 122, pl. ii, figs. 1-8; also *Productus Calhounianus*, Swallow (1858), Trans. Acad. Sci. St. Louis, I, 180.

Shell attaining a large size, longer (measuring over the curve of the ventral valve) than wide; hinge apparently not quite equaling the greatest breadth. Ventral valvê very gibbous, much produced anteriorly, very strongly arched, and provided with a deep, wide mesial sinus that extends from the umbonal region to the produced front, to which it gives an emarginated appearance as seen from above; most gibbous portion on each side of the sinus, comparatively narrow, with abruptly descending lateral slopes, which converge rather gradually to the beak; ears apparently nearly rectangular, arched, and wrinkled; surface ornamented by medium-sized, well-defined, occasionally bifurcating costæ, that bear numerous, more or less alternately-arranged little nodes, each of which was the base of a slender spine sometimes apparently attaining a length of nearly three-quarters of an inch; beak comparatively small at the apex, incurved so as to pass within the hinge-line, and, together with the adjacent umbonal region, crossed by small concentric wrinkles, which become stronger on the ears; lines of growth very fine and regular. Dorsal valve somewhat flattened or a little concave in the visceral region, and abruptly curved parallel to the other in front, provided with a mesial ridge corresponding to the sinus of the other valve; surface ornamented with costæ similar to those of the other valve, and crossed on the visceral region by small, regular concentric wrinkles; cardinal edge strengthened within by a strong marginal ridge on each side of the short, recurved cardinal process, from the base of which there extends forward a small mesial ridge, which is bifid at its connection with the process.

Length of one of the largest specimens, measuring over the curve of the

ventral valve, about 4.90 inches; breadth of the gibbous part of umbonal region, exclusive of the ears, about 2.50 inches.

Of this *Productus*, there are six or eight specimens in the collection from various localities, but unfortunately they are all more or less mutilated or distorted. After numerous careful comparisons, I have been unable to arrive at any very satisfactory conclusions in regard to its specific relations. At a first glance, it reminds one of some of the larger coarsely-costated varieties of *P. semireticulatus*. It evidently differs, however, in several respects from that species; being not only more coarsely costated, and more deeply sulcated, but it likewise differs in having numerous little spines scattered over the whole of the ventral valve; while the mesial internal ridge of its dorsal valve (see fig. 6 *b*) differs in being bifid as in *P. scabriculus*. In most of its external characters at least, excepting its narrower form, it seems to agree pretty well with the description of a form described by Professor Swallow, from the Upper Coal-Measures of Kansas, under the name *P. Calhounianus* var. *Kansasensis*; and yet it appears to be specifically distinct from the Kansas specimens that I have always identified with the form described by Professor Swallow, as well as from all of the others I have ever seen from the same localities as those named by him. It appears also to be related to *P. Ivesii* of Dr. Newberry, from Arizona, but is more produced anteriorly; and, so far as I have been able to see from examinations of the interior of the dorsal valve of that form, its mesial ridge is not divided as in this shell, which is also narrower in the umbonal region.

I suspect that it will be found to be an unnamed species; but, without better specimens for comparison, I hardly feel justifiable in naming it as a new species. If distinct from all the allied forms, it might be called *P. longus*.

Locality and position.—Fossil Hill, White Pine Mountains; Railroad Cañon, Diamond Mountains; West of San Francisco Mountain, etc.

PRODUCTUS SEMIRETICULATUS, Martin.

Plate 7, fig. 5.

- Anomites semireticulatus*, Martin (1709), Petref. Derb., 7, tab. xxxii, figs. 1 and 2, and tab. xxxiii, fig. 4.
- Anomites productus*, ib., 9, tab. xxii, figs. 1, 2, and 3.
- Productus Scoticus*, Sowerby (1814), Min. Conch., I, 158, tab. lxi, fig. 3.
- Productus Martini*, Sowerby (1821), ib., IV, 15, pl. 317, figs. 2-4.—De Koninck (1843), An. Foss. Carb. Belg., 160, pl. vii, fig. 2.—Phillips (in part, 1836), Geol. Yorks., II, 213, pl. vii, fig. 2.—McCoy (in part, 1844).—Brit. Pal. Foss., 467 and 471.
- Productus antiquatus*, Sowerby (1821), Min. Conch., II, 15, pl. 317, figs. 1, 5, and 6.—Phillips (part, 1836), II, 213, pl. vi, fig. 2.
- Productus concinnus*, Sowerby (1821), Min. Conch., IV, 16, pl. 318, fig. 1.
- Productus pugilis*, Phillips (1836), Geol. Yorks., II, viii, fig. 6.
- Leptæna antiquata*, Fischer (1837), Oryc. du Gouv. de Mosc., 142, pl. 26, figs. 4 and 5.
- Leptæna tubulifera*, Fischer, ib., pl. xxvi, fig. 1 (not Deshayes).
- Productus Inca*, d'Orbigny (1844), Paléont. Am. Mérid., 51, pl. iv, figs. 1, 2, and 3.
- Productus flexistriata*, McCoy (1844), Synop. Carb. Foss. Ireland, pl. xvii, fig. 1.
- Productus semireticulatus*, De Koninck (1847), Monogr. Chonetes et Prod., pl. viii, fig. 1, pl. ix, fig. 1, pl. x, fig. 1.—Davidson (1860), Monogr. Scottish Carb. Brach., pl. iv, figs. 1-5, 7, and 12; and of numerous other authors.

The collection contains, from several localities, specimens that seem to me to belong to the above-mentioned well-known and widely-distributed species. At least so far as their characters can be made out from the collections yet obtained for study, no reliable distinctions have been observed.

Locality and position.—Railroad Cañon, Diamond Mountains; Fossil Hill, White Pine Mountains, Nevada.

PRODUCTUS COSTATUS, Sowerby ??, var.

Plate 7, figs. 4 and 4 a, b.

- Productus costatus*, Sowerby (1827), Mineral Conch., VI, 115, pl. 560, fig. 1.—De Verneuil (1845), Palæont. Russia and the Ural Mts., 268, pl. xv, figs. 13 a, b.—De Koninck (1847), Mon. Prod., 92, pl. viii, fig. 3,* pl. x, fig. 3, and pl. xviii, figs. 3 a, b.—Davidson (1860), Mon. Scottish Brach., 44, pl. ii, figs. 22-24; and of various other authors.
- Productus sulcatus*, Sowerby (1822), Mineral Conch., IV, 17, pl. 319, fig. 2.
- Producta costata (et sulcata)*, Phillips (1836), Geol. Yorks., 213, pl. vii, fig. 2.
- Productus costellatus*, McCoy (1844), Synopsis Carb. Foss. Ireland, pl. xx, fig. 15.
- Productus Portlockianus*, Norwood and Pratten (1854), Jour. Acad. Nat. Sci. Philad., III, 15, pl. 1, figs. 9 a, b, c.

* This figure of De Koninck's was drawn from an American specimen found at Saint Louis, Missouri.

Producta costata, McCoy (1855), Brit. Pal. Foss., 460.

Producta Flemingi var. *sulcata*, McCoy, ib., 461.

Productus costatus, Meek (1872), Palæont. E. Nebraska, in Hayden's Report U. S. Geol. Survey Nebraska, 159, pl. vi, figs. 6 *a*, *b*.

Shell rather under medium size, about as long as wide, measuring direct from the beak to the front, but longer than wide, measuring over the curve of the ventral valve; very gibbous, and strongly incurved, the curvature increasing little from the front to the beak, and sometimes describing nearly two-thirds of an entire revolution on the ventral surface; hinge-line about equaling the greatest breadth of the valves. Ventral valve very gibbous, with a well-defined mesial sinus extending from the umbonal region to the front; ears small, nearly rectangular, and rather distinctly arched; lateral slopes rounding off nearly vertically to the ears; beak gibbous, and strongly incurved, but scarcely passing within the hinge-margin; surface ornamented with moderate-sized longitudinal costæ, which sometimes become a little irregular in size on the anterior and anterior lateral slopes by some of them bifurcating, or, in other cases, by two of them coalescing to form a larger and slightly more prominent one, generally at the origin of a spine. Small concentric wrinkles also give the visceral region a more or less reticulated appearance, while the bases of rather stout spines are seen scattered over the anterior and lateral slopes (generally on the larger costæ) as well as on the ears, or sometimes in a row along the sulcus or concavity between each ear and the very abrupt swell of the umbo. Dorsal valve flattened-concave in the visceral region, where it is marked by obscure costæ and small concentric wrinkles; interior with a slender mesial ridge, most sharply elevated near the middle, and having the muscular scars prominent and near the beak; reniform scars obscure, directed outward and a little forward from the anterior side of the muscular scars.

Length of a medium-sized specimen, measuring direct from the beak to the front, 1.21 inches; measuring over the curve of the ventral valve, about 2.20 inches; breadth, 1.25 inches.

It is with considerable doubt that I have ventured to refer this shell to the variable species *P. costatus*, though it seems to be the form that has generally been identified with that species in our Coal-Measures and the Lower Carboniferous rocks of the Mississippi Valley. Although these American

specimens agree pretty closely with certain forms usually regarded in Europe as being only varieties of *P. costatus*, they *never* possess the very large costæ and the strong oblique lateral ridge near each ear, seen in the typical variety of that species. Indeed, I have never seen any American shell presenting the characters of the typical *P. costatus*, or nearly approaching it. It is therefore only because the best European authorities include in that species shells with very much smaller costæ, and the lateral ridges nearly or quite obsolete (such as that represented by figs. 6 and 6 *a* on plate 4 of Mr. Davidson's Monograph of the Carboniferous Brachiopoda of Scotland, first referred by Mr. Davidson to *P. semireticulatus*, but afterward considered by him to be a variety of *P. costatus*), that we have in this country referred such forms as that under consideration, even provisionally, to *P. costatus*. Generally, our specimens resemble quite closely *P. sulcatus* of Sowerby; and if it were not for the fact that nearly all European authorities who have investigated the Carboniferous *Brachiopoda* agree in viewing the form on which Sowerby proposed to found that name as only a variety of *P. costatus*, I should scarcely hesitate to retain the name *P. sulcatus* for our shell. Our specimens, however, are generally more gibbous and more strongly arched than the European varieties of *P. costatus* with equally small costæ. In most cases, they look much like small examples of *P. semireticulatus*; and, indeed, Mr. Davidson thought that specimens apparently of this shell sent by me to him from the Coal-Measures of Nebraska more probably belonged to that species than to *P. costatus*; yet the fact that we find these shells throughout wide areas of country here ranging through a considerable thickness of strata, and often directly associated in the same beds with well-marked examples of *P. semireticulatus* of the usual size and form, and still never attaining more than half the adult size of that species, while they are always proportionally narrower across the umbonal region, and more gibbous and more produced, seems to be an objection to the conclusion that they belong to the same species; especially as these smaller shells are evidently, as may be seen by their much-produced, strongly-arched form, adult specimens. On the other hand, the fact that they vary comparatively little in their characters, wherever we find them, and *never* nearly approach the typical forms of *P. costatus*, would seem to be an equally good reason for

regarding them as belonging to a distinct species from that form also. Until we can have an opportunity to arrive at a more satisfactory conclusion on these points from the study of more extensive collections, I would therefore refer this form provisionally to *P. costatus*, but at the same time express the belief that it does not belong to the same species as the typical *P. costatus* of the Old World.

Locality and position.—Railroad Cañon, Diamond Mountains; Fossil Hill, White Pine Mountain; and Moleen Peak, Nevada.

PRODUCTUS PRATTENIANUS, Norwood.

Plate 7, fig. 7.

Productus cora, Owen (1852), Geol. Report Wisconsin, Iowa, and Minn., 103 and 136, pl. v, fig. 1.—Marcou (1858), Geol. N. Am., 45, pl. vii, figs. 4, 4 a.

Productus semireticulatus, Hall (1852), Stansbury's Report Salt Lake Exp., 411, pl. iii, figs. 3, 5, and 5 a, b (not Martin, sp.).

Productus Prattenianus, Norwood (1854), Jour. Acad. Nat. Sci. Philad. (2d ser.), III, p. 17, pl. 1, figs. 10 a, b, c, d.

Productus Flemingii, Geinitz (1866), Carbonf. und Dyas in Nebraska, 52, taf. iv, figs. 1, 2, 3 (not Sowerby).

Compare *P. cora*, d'Orbigny (1843), Paléont. Voy. Am. Mérid., III, 55, pl. v, figs. 8, 9.

This is a common shell in the Coal-Measures of the Mississippi Valley, through the whole thickness of which it ranges, if not into the Lower Carboniferous. It is generally about as wide as long, by direct measurement from beak to front; though in some examples the anterior margin is more produced. The hinge-line usually equals the greatest breadth; while the ears are large, rectangular, and marked with a few large wrinkles that extend a little upon the sides of the umbo, but never cross over it, the visceral region of the ventral valve being nearly always without traces of these wrinkles. It is very gibbous, strongly-arched in the umbonal region, and without any indications of a mesial sinus, though it is sometimes a little flattened in the middle, with the lateral slopes rounding down abruptly on each side. The beak is often narrowed and distinctly incurved. The surface is ornamented by fine, regular, longitudinal striæ, which increase by intercalation, or sometimes by division; while over the whole of the ventral valve are distantly, but regularly scattered, a few large spine-bases, at each of which the striæ are often interrupted, sometimes three or four of them termi-

nating at a spine-base, or three or four originating on the lower side, where only one is continued above the same. The spines are large, erect, and apparently long, and occur on the ears as well as over the other parts of the valve, there being sometimes a row of them along the hinge-margin of each ear. The dorsal valve is flattened, and generally provided with concentric wrinkles on the visceral portion.

Although this species is quite common, it is rarely found with the ears and free margins unbroken. In most cases, only the umbonal and most gibbous parts of the ventral valve are preserved when the specimens are broken from a limestone matrix; while, owing to the thinness of the shell, specimens in shale are usually crushed or much distorted. It seems to be much like forms identified in Europe with *P. cora*, d'Orbigny, to which it has been by some referred in this country. It certainly differs from d'Orbigny's figures of that species, however, in having its ventral valve more gibbous, with more nearly rectangular and larger ears, with large strong wrinkles; while its spines were certainly much larger and longer than represented by d'Orbigny. If his figure represents a specimen with the free margins and the edges of the ears broken away, and the *short*, pointed spines shown along the hinge are wrongly drawn, then his species may be identical with our shell; but otherwise it seems to me to be quite distinct. Prof. De Koninck, however, who has seen d'Orbigny's original specimens, thinks they are certainly not distinct from the European forms referred to *P. cora*, some of which are much more like our shell than the South American typical form would appear to be from d'Orbigny's figure.

As in other species of the genus, the striæ of this shell vary somewhat in size, though much less than is usual in most other species. On measurement, I find that from three to five of them may be counted in a space of one-tenth of an inch in the specimens under consideration.

Locality and position.—Fossil Hill, White Pine District; Railroad Cañon, Diamond Mountains, Nevada: Carboniferous.

PRODUCTUS SEMISTRIATUS, Meek.

Plate 7, figs. 8, 8 a.

Productus semistriatus, Meek (1860), Proceed. Acad. Nat. Sci., XII, 309; and (1876) in Col. Simpson's Report Expl. across the Great Basin of Utah, 347, pl. I, figs. 7 a, b. Compare *Productus Chandlessii*, Derby (1874), Bull. Cornell Univ., I, 51, pl. iv, figs. 1-16, and pl. vi, fig. 1.

Shell rather under medium size, very gibbous, greatest breadth on the hinge-line, which is nearly twice the length, measuring from the beak direct to the anterior slope, but only a little more than half as great as the length of the ventral valve, measuring over its curve. Ventral valve extremely convex, strongly arched, and much produced in front, sometimes provided with a very shallow mesial sinus; beak gibbous and distinctly incurved, so as to pass within the cardinal margin; ears triangular, strongly vaulted, and abruptly separated from the vertical sides of the gibbous umbonal region by a rounded, undefined sulcus, which is continued from the beak to the lateral margins, to the outline of which it imparts a more or less sinuous character in front of each ear; surface of the visceral region marked by small concentric wrinkles extending upon the ears, and crossed by numerous rather fine longitudinal striæ, or costæ, that become suddenly obsolete on all of the anterior and lateral slopes from above (behind) the middle: these parts of the surface being merely marked with obscure lines of growth and strong, regularly-scattered spine-bases, from each of which there is sometimes a very obscure, undefined ridge extending downward to or toward the free margin. Similar spine-bases are also seen over other parts of the surface, including the ears; though they nowhere arise from tubercles. Dorsal valve unknown.

Length, measuring direct from the umbo to the anterior slope, 0.83 inch; measuring over the curve of the ventral valve from the beak to the anterior margin, 2.25 inches; breadth to the extremities of the ears, about 1.34 inches; breadth of most gibbous part of umbonal region, 0.90 inch; number of longitudinal striæ on the posterior half of the ventral valve, in the space of 0.10 inch, 3.

This seems to be a well-marked species, which is peculiar in having well-defined longitudinal striæ and moderately distinct transverse wrinkles

on the gibbous visceral region of the ventral valve, and no traces whatever of either on the anterior and lateral slopes, composing more than half of the entire surface. The ventral valve is very gibbous, distinctly arched, and much produced; the elevated umbonal region being comparatively narrow, with vertical sides, and but a faint indication of a mesial sinus. The spines seem to have been stout, erect, and to have arisen very abruptly from the surface, without being connected with tubercles.

In several respects, the South American shell described by Professor Derby, under the name *Productus Chandlessii*, in the Bulletin of Cornell University, already cited, would seem, as nearly as can be determined from his figures and description, to be closely allied to the species here under consideration; but, without specimens for comparison, I am not prepared to express a decided opinion respecting the relations of the two shells.

Locality and position.—The type-specimens of this species were brought by Colonel Simpson from a locality southeast of the Great Salt Lake, Utah (latitude $40^{\circ} 22' N.$, longitude $111^{\circ} 38' W.$), where they were found in a black bituminous limestone of Carboniferous age.

PRODUCTUS SUBHORRIDUS, Meek.

Plate 7, figs. 3, 3a, 3b.

Shell small, or of moderate size, generally much produced, longitudinally oblong-suboval, the length being distinctly greater than its breadth; hinge-line about equaling the greatest breadth. Ventral valve very gibbous, especially in the umbonal region, with a deep mesial sinus extending from near the umbo to the front, very strongly arched, the curve increasing from the front to the beak, which is distinctly incurved, but scarcely passes the hinge-margin; ears small, nearly rectangular, arched, and standing out nearly at right angles to the abrupt sides of the umbo; surface smooth, excepting sometimes broad, obscure, obsolescent longitudinal ridges on the anterior and lateral slopes, and strong spine-bases, rather thickly scattered over the whole, including the ears; spines strong, erect, and long. Dorsal valve and interior unknown.

Breadth of a medium-sized specimen, 0.85 inch; length of the same, measuring direct, 1.03 inches; measuring over the curve of the ventral valve, 2.06 inches.

In its smooth surface, deep mesial sinus, and strong spines, this species resembles the narrowest varieties of *Productus horridus* of Sowerby. Its uniform adult size, however, from widely-separated localities, and through a great thickness of strata, is less than half that of the average size of *P. horridus*; while it is greatly more produced and elongated in proportion to breadth, and has a proportionally shorter hinge and smaller ears. All its associate fossils in the same beds are also decidedly Carboniferous forms, while *P. horridus* is a Permian species.

In some respects, this shell resembles a form described by Professor Swallow, from the Coal-Measures of Kansas, under the name *P. costatoides*. It attains a larger size, however, and is more produced anteriorly; while it wants the well-defined costæ of that shell, being almost entirely smooth, excepting the spine-bases, and the faintest possible traces of a few broad, undefined ridges, sometimes seen descending the anterior slope. It never shows the faintest indications of concentric ridges, or furrows, on the visceral region, or any other part of the surface.

Locality and position.—Light-colored Carboniferous limestone of Wasatch Mountains; Hamilton Butte, Ruby Group; Mahogany Peak, Egan Mountains, and north slope of Moleen Peak, Elko Range, west side of Long Valley, Ruby Group.

PRODUCTUS MULTISTRIATUS, Meek.

Plate 8, figs. 3, 3 a, 3 b, 3 c, 3 d, 3 e.

Productus multistriatus, Meek (1860), Proceed. Acad. Nat. Sci. Philad., July, 309; and (1876) in Col. Simpson's Report Expl. across the Great Basin of Utah, 350, pl. 1, figs. 8 a, b.

Shell of about medium size, much produced; length of entire specimens greater than the breadth, even by direct measurement from the umbo to the produced front, and proportionally still longer, measuring over the curve of the ventral valve; ears of moderate, or rather large size, somewhat triangular, strongly vaulted, and defined by a sinuosity of each lateral margin, which generally makes them less than rectangular at the extremities; lateral margins rounding anteriorly from the sinuosity in advance of each ear, to the front, which is distinctly sinuous in outline at the middle. Ventral valve extremely gibbous, very strongly arched, and provided with a profound mesial sinus, which extends from near the umbo to the front;

umbonal region, behind the most gibbous part, depressed-convex, and without traces of transverse wrinkles; beak incurved, but not passing far within the hinge-line; most convex portion on each side of the mesial sinus prominently rounded, with very abrupt lateral slopes. Ventral valve deeply concave, but more or less flattened in the visceral region, where there commences a broad mesial ridge, corresponding to the sinus of the other valve, while a low prominence extends out from near the umbo to the sinuous part of each lateral margin in front of each ear, internally showing a sudden geniculation around the front and lateral margins, nearly at right angles to the more or less flattened visceral region; muscular and reniform scars unknown. Surface of both valves ornamented by numerous fine, regular, rather obscure, longitudinal costæ, or striæ, apparently generally destitute of spines, though sometimes a few very scattering large spine-bases are seen on the anterior slope of the dorsal valve, as well as on the ears of the same, where they, on some specimens, form a row along the hinge-margin.

Greatest length, measuring from the most gibbous part of the umbonal region to the front, about 1.90 inches; from the strongly-incurved beak to the front, 1.15 inches; breadth, to the extremities of the ears, 1.64 inches; convexity of the ventral valve, 1 inch; number of surface striæ in 0.10 of an inch, 3 or 4.

Of this species, there are some fifteen or twenty specimens before me, in various states of preservation, all of which are remarkably uniform in nearly all their characters. Its most marked features are its very gibbous form, deep mesial sinus, dividing the ventral valve into two prominently-rounded lobes, its somewhat depressed umbonal region without any traces of transverse wrinkles, and its fine, even striæ, with only a very few scattering, large spine-bases, sometimes seen on the anterior slope, and near the hinge-margin of the ears. The sudden geniculation of the dorsal valve around the anterior and lateral margins of the flattened visceral region, is also so strongly marked as to give the internal view of this valve much the form of *Strophomena rhomboidalis* (see fig. 3 e), excepting that it wants the concentric wrinkles of that shell. Although there are specimens in the collection showing this character very satisfactorily, unfortunately none of them

are in a condition to show the muscular or reniform impressions, nor very clearly the form of the cardinal process.

Generally, on somewhat worn specimens, the fine striæ are so nearly obsolete that the surface presents the appearance, at a first glance, of being entirely smooth; but even these specimens nearly always show remains of the striæ on the more protected parts, while, where the surface is well preserved, they are always seen distinctly defined on all parts.

I am not acquainted with any other species nearly enough allied to this to render a comparison necessary.

Locality and position.—The original type-specimens of this species were brought by Colonel Simpson's party from latitude $39^{\circ} 51' N.$, longitude $115^{\circ} 10' W.$, near the center of the eastern margin of Nevada. Those in Mr. King's collection came from further west, in the Ruby Group, and Mahogany Peak, Egan Range; the matrix being, in all cases, a light-colored limestone. I have never seen it from any other localities, and know of no nearly allied form in the rocks of the Mississippi Valley. Its associates are always well-marked Carboniferous types.

PRODUCTUS LONGISPINUS, Sowerby.

Plate 8, figs. 4, 4 a.

Productus longispinus, Sowerby (1814), Min. Conch., I, 154, pl. lxxviii, fig. 1.—De Koninck (1847), Descrip. An. Foss. Carb. Belg., 187, pl. xii, figs. 11 a, b, and pl. xii bis, fig. 2.—Davidson (1853), Introd. Brit. Foss. Brach., pl. ix, fig. 221; also (1860), Monogr. Scottish Carb. Brach., pl. ii, figs. 10–19; and (1861) Brit. Carb. Brach., 154, pl. xxxv, figs. 5–17.

Productus Flemingii, Sowerby (1814), Min. Conch., I, 154, pl. 68, fig. 2.—De Koninck (1847), Monogr. Prod., pl. x, fig. 2.—McCoy (1855), Brit. Pal. Foss., 461.

Productus spinosus, Sowerby (1814), Min. Conch., I, 157, pl. 69, fig. 2.

Productus lobatus, Sowerby (1821), ib., IV, 16, pl. 318, figs. 2–6.—Von Buch (1841), Ver. Königl. Akad. Wiss., Theil I, 32, pl. ii, fig. 17.—De Verneuil (1845), Geol. Russ. and Ural Mts., II, 266, pl. xvi, fig. 3, and pl. xviii, fig. 8.

Productus elegans, Davereux (1833), Const. Géol. de la Prov. de Liège, 272.

Producta setosa, Phillips (1833), Geol. Yorks., II, 214, pl. viii, figs. 9 and 17.

Productus Capacii, d'Orbigny (1843), Paléont. Voy. Am. Mérid., 50, pl. iii, figs. 24–26.

Productus tuberosus, De Keyserling (1846), Petschora Land, 208, pl. iv, fig. 6.

Productus Wabashensis, Norwood and Pratten (1854), Jour. Acad. Nat. Sci. Philad., III, pl. i, fig. 6.

?*Productus splendens*, ib., pl. i, fig. 5.

The specimens of the little shell that I have, with doubt, referred to the above species, are not in a very good state of preservation; but, as far as their characters can be made out, they seem to agree at least with forms

regarded by reliable authorities as being varieties of Sowerby's species. The best specimen in the collection is represented by the figs. 4, 4 *a*, on plate 8. This is more gibbous in the umbonal region, and has larger costæ than the most characteristic examples of *P. longispinus*, while it shows no traces of the mesial sinus usually seen in the same. In these respects, however, it agrees more nearly with a form illustrated as a variety of that species by Mr. Davidson's figs. 19, 19 *a*, plate xxxv, of his Monogr. Brit. Carb. Brach. It is true that it does not show the angular projection of the anterior margin seen in Mr. Davidson's figure, but its anterior margin is broken. Some of the other more imperfect specimens, however, show the usual mesial sinus, and the smaller costæ, exactly as in characteristic examples of *P. longispinus*. Generally, the surface is exfoliated, and the spines broken away; but, in a few instances, some remaining traces of their bases can be seen, while fragments of comparatively stout spines, like those of Sowerby's species, occur closely associated in the same matrix.

Locality and position.—Fossil Hill, White Pine District, Nevada; in light-colored Carboniferous limestone.

RHYNCHONELLIDÆ.

Genus LEIORHYNCHUS, Hall.

LEIORHYNCHUS QUADRICOSTATUS, Vanuxem ? (sp.).

Plate 3, figs. 9, 9 *a*, 9 *b*.

Orthis quadricostatus, Vanux. (1842), Geol. Rep. Third Dist. N. Y., 186.

Leiorhynchus quadricostatus, Hall (1843), Regent's Thirteenth Rep., 86; and Pal. N. Y. iv, 357.

Shell trigonal-subovate, or subcircular, very thin, and apparently compressed; posterior lateral margins somewhat straightened, and diverging from the beaks at about a right angle; anterior lateral margins rounding to the front, which is generally a little protuberant in the middle, but sometimes rounded, or even faintly sinuous in outline. Dorsal valve apparently more convex than the other, and provided with a depressed mesial fold, which extends little farther than the middle, and bears four, or rarely five, low, rounded costæ, which do not reach the umbonal region; lateral surfaces smooth, or only showing very faint traces of a few undefined radiating costæ. Ventral valve with a shallow mesial sinus, corresponding to the fold of the other valve, and bearing three, or rarely four, obscure costæ, while

very faint traces of a few similar costæ are sometimes seen on each side of the sinus. Surface of both valves marked by fine lines, and more or less stronger sulcations of growth, which undulate gracefully in crossing the costæ.

Length, 1 inch; breadth, 0.93 inch; convexity unknown. One proportionally broader specimen measures 0.93 inch in length and 1.06 inches in breadth.

The specimens of this shell in the collections studied by me are merely distorted casts with portions of the shell attached. These so nearly resemble *Leiorhynchus multicostatus*, Hall (supposed by Professor Hall to be probably only a variety of *L. quadricostatus*, Vanuxem, sp., from the Hamilton Group, N. Y.), that I had called attention to the close similarity. On comparison, however, with the figures and descriptions of the N. Y. shell, I thought them most probably distinct, and had proposed, in manuscript, a new name for them. Since then Professor Hall and Mr. Whitfield, who have investigated Mr. King's later collections, have referred this shell to *L. quadricostatus*, Vanuxem (see Am. Jour. Sci., XI, 475, June, 1875). As they have had the advantage of making direct comparisons with authentic New York specimens of Vanuxem's species, which I had no opportunity to do, it is presumable that they are more apt to be correct. Consequently, as these pages are passing through the press, I have withdrawn my proposed name; and, as it has never been published with a description, it need not be cited in synonymy.

The group *Leiorhynchus* seems to be, so far as yet known, distinguished from the older types of *Rhynchonella* more by the obscurity and obsolescent character of its plications, and other superficial characters, than by any observed fundamental differences of the muscular or other internal peculiarities. The known New York species are found only in the Hamilton and Chemung Groups of the Devonian.

Locality and position.—White Pine Mountains, Nevada; where it occurs in a dark shale. If a true *Leiorhynchus*, and especially if identical specifically with the New York shell referred to, the black shale from which it was obtained, would be almost certainly, as I had suspected, Devonian, and not Carboniferous.

SPIRIFERIDÆ.

Genus *ATHYRIS*, McCoy.*ATHYRIS?* *PERSINUATA*, Meek.

Plate 9, figs. 4, 4 a, 4 b.

Shell subtrigonal, very gibbous, somewhat longer than wide; lateral margins rounded in outline; front prominent in the middle; connecting margins of the valves, on each side of the beaks, broadly and deeply sinuous (see fig. 4 b.) Dorsal valve much more convex than the other, its greatest convexity being at the middle of the front, where it is elevated in the form of a very prominent, rounded, mesial fold, which projects somewhat forward, and scarcely extends back to the middle; lateral slopes rounding abruptly downward, and considerably produced, so as to meet the margins of the other valve nearly at right angles; beak strongly incurved. Ventral valve moderately convex in the umbonal region, and depressed in front into a broad, rounded, or somewhat flattened and profound mesial sinus, which causes the anterior margin to project obliquely forward and upward as a linguiform extension filling a corresponding sinus in the margin of the other valve, which it intersects at less than a right angle; beak unknown. Surface of both valves apparently nearly smooth, excepting rather distinct, subimbricating marks of growth near the anterior and lateral margins.

Length, about 1.28 inches; breadth, 1.16 inches; convexity, 0.98 inch.

Although I have seen no entire specimens of this shell, those I have had an opportunity to examine seem to differ so widely, not only from all the other forms in the collection, but from any described species of which I have seen figures or specimens, that there appears to be little, if any, reason to doubt that it is a new species. At a first glance, its extremely elevated fold and deep sinus remind one of *Rhynchonella acuminata*; but, on closer inspection, this fold is seen to be merely rounded, instead of angular, or divided into several smaller ridges, as we see in that shell. I am in some little doubt, however, whether or not it is really a true *Athyris*, since none of the specimens show the beak of the ventral valve, or, very clearly, any of the internal characters. One internal cast of the dorsal valve shows that it has a mesial ridge, or low septum, in the umbo, much as we often

see in *Rhynchonella*; but some scars of the adductor muscles seen near the middle of the valve seem to be more like those of *Athyris*. If a *Rhynchonella*, it would, of course, belong to the section of the genus including *R. acuminata*.

Locality and position.—Light-colored Carboniferous limestone of White Pine Mountains, Nevada.

ATHYRIS ROISSYI, l'Eveillé (sp.).

Plate 9, figs. 3, 3 a, 3 b.

Spirifer de Roissyi, l'Eveillé (1835), Mém. Soc. Géol. France, II, 39, pl. ii, figs. 18–20.

Spirifer glabristriatus, Phillips (1836), Geol. Yorks., II, 220, pl. x, fig. 19.

Spirifer fimbriatus, Phillips, ib., 220.

Terebratula Roissyi, De Verneuil (1840), Bull. Soc. Géol. France, XI, 259, pl. iii, figs.

1 b, c, d (not 1 a and e).—De Koninck (1843), An. Foss. Carb. Belg., 300, pl. xxi, fig. 1 (not pl. xx, fig. 1).

Athyris depressa, McCoy (1844), Synop. Carb. Foss. Ireland, 147, pl. xviii, fig. 7.

Athyris de Roissyi, McCoy (1855), Brit. Pal. Foss., 433.

Athyris glabristriata, McCoy, ib., 434.

Athyris Roysii, Davidson (1860), Monogr. Carb. Brach. Scotland, 16, pl. i, fig. 12; and (1861) Brit. Carb. Brach., 84, pl. xviii, figs. 1–11.

? *Athyris sublamellosa*, Hall (1858), Iowa Report, II, part 2, 702, pl. xxvii, figs. 1 a, b, c.

There are among the collections before me a number of specimens, some of which agree very closely with *A. Roissyi* in form, size, and general appearance; but, as none of them show the fringed lamellæ of growth so characteristic of l'Eveillé's species, it is with considerable doubt that I have identified them with that widely-distributed Carboniferous form. Still, as the peculiar surface-markings are said not to be always preserved in specimens of *A. Roissyi*, it is quite possible that they may have originally existed in our specimens, which came from a limestone matrix. They all show rather distinct, subimbricating marks of growth, but without traces of projecting fimbriated lamellæ. Some of the larger specimens have exactly the transversely-oval form and well-defined mesial sinus seen in mature, wide individuals of *A. Roissyi*; while other smaller individuals are proportionally narrower, with a much more prominent beak, and more rapidly-sloping posterior lateral margins, thus passing by easy gradations into forms that it is difficult to separate from *A. subtilita*, Hall, especially in specimens that have the surface-markings not well preserved. The adult specimens all show the sinus of the ventral valve terminating in a rounded marginal

projection, fitting into a corresponding sinuosity in the front of the other valve, just as we see in *A. Roissyi*; but the sinus in all of them becomes a narrow, very shallow sulcus, at a short distance from the front, instead of being broadly rounded or somewhat flattened, as we usually see in large examples of l'Eveillé's species.

Locality and position.—From the light-colored Carboniferous limestones of Ruby Group; also, from same in Wachoe Mountains; Mahogany Peak; Egan Range, Nevada.

ATHYRIS SUBTILITA, Hall.

Plate 8, figs. 6, 6 a.

Spirifer Roissyi, d'Orbigny (1843), Voy. dans Amér. Mérid., 46, pl. iii, figs. 17 and 19, (by error marked *Terebratula Peruviana* on the plate; not *Athyris Roissyi*, l'Eveillé, sp.).

Terebratula subtilita, Hall (1852), Stansbury's Report Salt Lake Exp., 409, pl. 4, figs. 1 and 2; and again (1858) in Iowa Geol. Report, I, part ii, 714.—Marcou (1858), Geol. N. Am., 52, pl. vi, figs. 9 a, b, c, d, e, f.

Athyris differentis, McChesney (1860), Descriptions New Palæozoic Fossils, 47.

Athyris subtilita, Davidson (1861), Brit. Carb. Brach., 86, pl. i, figs. 21–22, and pl. xvii, figs. 8–10.—Salter (1861), Quart. Jour. Geol. Soc., XVII, pl. iv, figs. 4 a, b.—Meek (1876), in Col. Simpson's Report Expl. across the Great Basin of Utah, 350, pl. 2, figs. 4 a, b.

Compare *Terebratula argentea*, Shephard (1838), Am. Jour. Sci. and Arts, XXXIV, 152, fig. 8; also, *Athyris subquadrata*, Hall (1858), Iowa Report, I, part ii, 703, pl. 27, figs. 2 a, b, c, d.

Of this very common species, there are in the collection from several localities in Nevada well-marked and characteristic examples, agreeing in all respects with those found in the Coal-Measures of the Mississippi Valley, from Kansas and Nebraska to Texas, as well as westward to New Mexico, and eastward to Ohio. If *Athyris subquadrata*, Hall, is really identical with this species, which it certainly *very* closely resembles, then it must be common both to the Upper and Lower Carboniferous in the West; but if that is a distinct species, *A. subtilita* would seem to be confined, so far as known, to the Coal-Measures in the Mississippi Valley; though the English specimens referred to *A. subtilita* by Mr. Davidson came from the Lower Carboniferous.

Mr. Salter identified with this species a South American shell from the Andes, and also a form described from there by d'Orbigny, and referred by him to *Athyris Roissyi*: and, from the figures given by these authors, as well

as from the other fossils found in the same beds, I can scarcely doubt that this South American shell is really identical with *A. subtilita*.*

Although the figure given in the Journal of Science by Shephard, of the shell described by him in 1838 under the name *Terebratula argentea*, does not resemble adult forms of *A. subtilita*, I have long suspected that it represents an immature example of this species, as no other similar form is known among all the numerous specimens from our western Coal-Measures. If it should be found to be the same, Shephard's specific name would have to stand, as it has priority of date.

Locality and position.—Ruby Group; Moleen Peak; near Humboldt River, and other Nevada localities, in a light-colored limestone.

Genus SPIRIFERINA, d'Orbigny.

SPIRIFERINA (undt. sp.).

Plate 8, figs. 5, 5 a, 5 b.

Compare *Spirifer octoplicatus*, Sowerby (1827), Min. Conch., V, 120, pl. 562, figs. 2, 3, and 4 (= *Spiriferina cristata* var. *octoplicata* of Davidson and others).

Shell rather small, very gibbous, about equivalve, subtrigonal or rhombic-subquadrangular in general outline; hinge-line apparently equaling the greatest breadth. Ventral valve most convex in the umbonal region; beak incurved and projecting backward; mesial sinus narrow, well defined, somewhat flattened, and, without costæ within, continued to the point of the beak, and having its anterior margin produced forward in the form of a somewhat angular projection fitting into a corresponding sinus in the margin of the other valve; lateral slopes with each five to six elevated, simple, narrowly-rounded, or subangular costæ of the same size as the deep depressions between; cardinal area of moderate height, with well-defined margins that slope from the beak apparently to the lateral extremities of the hinge, rather strongly arched, and inclined obliquely backward. Dorsal valve with a narrow, very prominent, subangular, simple mesial fold, most elevated at or near the front, but continued to the beak, and projecting forward so as to give a rather acutely angular character to the outline of anterior margin;

* Since this was written, Professor Derby, of Cornell University, has identified *A. subtilita* from Brazil (see Bull. Cornell University, I, No. 2, 7.)

beak rather distinctly incurved and but very little projecting; lateral slopes costate as in the other valve. Surface of both valves with a few rather strong zigzag marks of growth, most distinct near the deeply interlocking, angular serratures of the anterior lateral margins, showing very clearly, under a common single lens, the rather large punctures regularly arranged in quincunx.

Length, measuring from the most prominent part of the ventral umbo to the front of the mesial fold of the dorsal valve, 0.82 inch; breadth, about 0.93 inch; convexity, 0.68 inch.

This shell seems to be related to a common form in our western Coal-Measures, generally known in this country by Dr. Shumard's name *S. Kentuckensis* (but supposed by Mr. Davidson not to differ from *S. octoplicata* of Sowerby), though it is probably distinct from Dr. Shumard's species. Without more and better specimens for comparison, however, I scarcely feel warranted in regarding it as new. The only individual of it in the collection has the lateral extremities broken away, but it is evidently a larger and more robust and more gibbous shell than any specimens of the form described by Dr. Shumard that I have seen, and differs both from that and the European typical *S. octoplicata* in having its mesial fold *much* more elevated, and projecting forward so as to impart a very distinctly angular outline to the middle of the anterior margin. Should other specimens show these characters to be constant, I should think it entitled to a distinct name, either as a species or as a variety, and would in that case propose to call it *S. gonionota*, in allusion to its high angular mesial fold.

Locality and position.—Light-colored limestone of Carboniferous age at Railroad Cañon, Diamond Mountains, Nevada.

SPIRIFERINA PULCHRA, Meek.

Plate 8, figs. 1, 1 a, b, c, d, e; and pl. 12, figs. 12 a, b, c, d ?.

Spirifera pulchra, Meek (1860), Proceed. Acad. Nat. Sci. Philad., XII, 310; and (1876) in Col. Simpson's Report of Expl. across the Great Basin of Utah, 352, pl. 2, figs. 1 a and 1 h.

Spiriferina pulchra, Meek (1865), Palæont. Upper Missouri, 19.

Shell of about medium size, transverse, rather compressed, or sometimes gibbous; breadth from twice to about three times the length; lateral

extremities more or less acutely angular; valves nearly equally convex, the dorsal being generally most convex in front, and the ventral in the umbonal region. Dorsal valve with its beak not very prominent or strongly incurved in the type-specimens, in which the area is rather narrow, well defined, narrowed to the lateral extremities, and a little arched and inclined backward over the hinge; foramen triangular, slightly higher than wide, and provided with a distinct marginal furrow on each side; mesial sinus rather narrow, well defined, smoothly rounded within, and commencing at the apex of the beak, from which it widens and deepens gradually to the front; lateral slopes on each side of the sinus ornamented by from nine to twelve or thirteen simple, prominent, rather acutely-rounded costæ. Ventral valve with a narrow, well-developed cardinal area, which generally tapers to the hinge-line before reaching the lateral extremities, and, with the short beak, arches rather strongly inward; mesial elevation simple, narrow, rounded, and continued to the beak; lateral slopes with their simple costæ corresponding in number and arrangement to those of the other valve. Surface of both valves with small, somewhat obscure, subimbricating lines of growth, which are rather distinctly arched in crossing the costæ, fold and sinus, showing the punctate structure very clearly under a common single pocket-magnifier.

Length (of one of the more compressed specimens), 0.95 inch; breadth of the same, about 1.76 inches; convexity, 0.52 inch.

Most of the typical specimens of this species are rather compressed, and have the lateral extremities extended and acutely pointed. Other specimens, however, from the same rock at localities a little farther north, found associated with the same group of fossils, are more gibbous, and have slightly smaller and a little more crowded costæ, with a somewhat higher and more arched area and beak. As the latter, however, vary somewhat in these respects, and agree exactly in all other known characters with the more compressed typical examples, I have not been willing to separate them.

Although not unlike some of the described species of *Spirifer* (*Trigonotreta*), I am not acquainted with any described species of *Spiriferina* so near this as to render a comparison necessary. It certainly belongs to

the latter group, being beautifully punctate, as can be readily seen with a common single lens, the punctures being so large as even to give the whole surface of internal casts a beautiful granular appearance; while casts of the rostral cavity of the ventral valve show a deep mesial slit, left by a well-defined mesial septum, as seen in fig. 1 *c* of plate 8.

Locality and position.—The typical specimens were brought by Colonel Simpson from a locality in Nevada, at latitude 40° N., longitude 115° 20' W.; the other more gibbous specimens in the collections under consideration came from White Pine County, twenty-five miles northeast of Hamilton, Ruby Group, Nevada: all from light-colored Carboniferous limestone.

A number of other specimens in the collection, from a light-grayish limestone at the mouth of Weber Cañon (see pl. 12, figs. 12, 12 *a*, 12 *b*, 12 *c*, 12 *d*), agree, so far as can be seen, in all respects with this species. Some of them are compressed like the typical specimens, while others are more gibbous, and agree exactly with those from the Ruby Group.

Genus SPIRIFER, Sowerby.

SPIRIFER CUSPIDATUS, Martin? (sp.).

Plate 3, figs. 11, 11 *a*.

Anomites cuspidatus, Martin (1796), Trans. Linn. Soc., IV, 44, pl. iii, figs. 1–6.

Conchylolithus (Anomites) cuspidatus, Martin (1809), Petref. Derb., I, 10, pl. 46, fig. 34, and pl. 47, fig. 5.

Spirifer cuspidatus, Sowerby (1816), Min. Conch., II, tab. 120, figs. 1–3; and of numerous later authors.

Delthyris cuspidatus, Keiferst. (1824), Naturges. des Erdk., II, 611.

Cyrtia simplex, McCoy (1844), Synop. Carb. Foss. Ireland (not of Phillips).

Cyrtia cuspidata, McCoy (1855), Brit. Pal. Foss., 466.

Of the form I have referred with doubt to the above-mentioned species, there is but one distorted specimen and a part of another in the collection. It seems to have had, before distortion, exactly the form, size, and surface-characters of a medium-sized individual of *S. cuspidatus*, excepting that its high area is arched a little backward, instead of being merely vertical or slightly arched forward, as seems to be generally the case with *S. cuspidatus*. As this, however, is doubtless a more or less variable character, unless known to be constant in a large number of specimens, and to be accom-

panied by some other differences, it would be unsafe to view our shell as belonging to a distinct species; though it is barely possible that it may prove to be such. One of the specimens shows that it has the transverse septum and the split tube between the dental laminæ, now known to exist in *S. cuspidatus*. I have not been able yet to see evidences of the shell being punctate, though I have not given it a thorough examination, and believe that it will be found to possess that character also.

Locality and position.—White Pine Mountains, Treasure Hill, Nevada; exact position not known, but it is believed to have come from a gray semi-crystalline limestone holding a position between well-marked Carboniferous and Devonian rocks, and probably belonging to the former epoch.

SPIRIFER (TRIGONOTRETA) OPIMUS, Hall ?.

Plate 9, fig. 6.

Spirifer opimus, Hall (1858), Geol. Report of Iowa, I, part ii, 711, pl. xxviii, figs. 1 *a, b*.
Spirifer subventricosus, McClesney (1860), Descriptions New Palæozoic Fossils, etc., 44; and Trans. Chicago Acad., I, pl. i, fig. 4.
 Compare *Spirifer bisulcatus*, Sowerby (1825), Min. Conch., V, 152, pl. 494, figs. 1 and 2; also *S. Rocky-montana*, Marcou (1858), N. Am. Geol., 50, pl. vii, figs. 4, 4 *a-e*; *S. Keokuk*, Hall, var. (1858), Iowa Report, I, pl. xx, and pl. xxv, and *S. increbescens*, Hall, ib., pl. xxvii, figs. 6 *a-i*; also *S. Keokuk*, var. *Shelbyensis*, Swallow (1867), Trans. St. Louis Acad., II.

Shell attaining nearly a medium size, moderately gibbous, subequivalve; hinge about equaling the greatest breadth; lateral extremities subrectangular, slightly rounded, or more or less than rectangular; front having a general subsemicircular outline, sometimes a little projecting in the middle. Ventral valve most convex in the umbonal region; beak rather pointed and distinctly incurved; area of moderate height, strongly striated vertically, and arched with the beak; mesial sinus narrow, rather shallow, and narrowing gradually to the apex of the beak, occupied by generally four costæ, a little smaller than those on each side, with which the lateral ones usually coalesce before reaching the umbo; lateral slopes each occupied by from eleven to thirteen, most generally simple, but sometimes in part bifurcating costæ, crossed on well-preserved specimens by moderately distinct, undulating marks of growth. Dorsal valve most convex near the middle; beak strongly incurved; mesial fold corresponding in size and form with

the sinus of the other valve, and, as well as the lateral margins, costated in the same way.

Length, 1 inch; breadth, about 1.30 inches.

I am not entirely satisfied that this shell is identical with *S. opimus*, Hall; though, so far as the specimens afford the means of comparison, it seems to present no constant essential differences. Professor Hall's figure in the Iowa report represents a short gibbous form of the shell with a rather high area; but collections from the Coal-Measures of the Western States show the shell to vary much in these characters. In fact, it is very questionable whether there are any reliable specific differences between *S. opimus* and *S. Keokuk* (including both Professor Hall's varieties of the latter) and *S. subventricosus*, McChesney. Again, some varieties of these shells very nearly resemble certain forms of *S. increbescens*, Hall; while several of the most distinguished European authorities consider the last-mentioned form itself identical with *S. bisulcatus*, Sowerby, an opinion in which I am much inclined to concur. It will also be noticed that our figure represents a shell almost exactly agreeing with some varieties of *S. bisulcatus*, as may be seen by comparing it with the variety of that species illustrated by fig. 8, plate vii, of Mr. Davidson's Monograph of British Carboniferous Brachio-poda. *S. bisulcatus*, seems to be, from the published illustrations, a variable form; and, according to the limits assigned it by European authors, might, so far as can be determined from comparison of external characters, take in all of the proposed species and varieties mentioned above. Dr. White considers *S. opimus*, Hall, and *S. Rocky-montana*, Marcou, identical, which may or may not be so; but however this may be, there is about as good reason for viewing all of the shells here mentioned as varieties of *S. bisulcatus*, Sowerby.

As I have not the necessary specimens at hand to attempt the solution of the question in regard to the relations of these American forms to each other and to *S. bisulcatus*, I have merely referred our shell to *S. opimus*, Hall, provisionally, for the present.

Locality and position.—Six miles south of Promontory Station, Promontory Mountains, Railroad Cañon, Moleen Peak; Mount Nebo, in Utah, and at longitude 111° 38' W., latitude 40° 22' N.; generally found in a

dark-colored limestone. There are specimens in the collection, however, from Fossil Hill, White Pine District, apparently belonging to this species, in a lighter-colored matrix. Everywhere in Carboniferous beds; and either the same or a closely-allied species occurs in the Coal-Measures of Illinois.

SPIRIFER (TRIGONOTRETA) SCOBINA, Meek.

Plate 9, figs. 1, 1 a, 1 b, 1 c, 1 d.

Spirifera scobina, Meek (1860), Proceed. Acad. Nat. Sci. Philad., XII, 310.

Spirifer (*Spiriferina*?) *scobina*, Meek (1876), in Col. Simpson's Report Expl. across the Great Basin of Utah, 351, pl. ii, figs. 5 a, b, c.

Shell attaining a moderately large size, truncato-subcircular, or approaching subpentagonal, rather gibbous, and more or less nearly equi-valve, with length and breadth scarcely differing; hinge-line about equaling, or a little less than the greatest breadth, and generally intersecting the lateral margins at rather obtuse angles; outline of front rounded, a little straightened, or probably sometimes slightly sinuous at the middle; lateral margins rounding to the front. Ventral valve generally a little more convex than the other; beak not very prominent, but strongly incurved; area well defined, of moderate breadth (height), and continued to the extremities of the hinge, more or less arched and directed a little obliquely backward; foramen wider than high; mesial sinus narrow and very shallow, but usually continued nearly to the beak, occupied at the front by about five smaller plications than those on the lateral slopes, the outer ones usually coalescing with the larger marginal one on each side before reaching the beak; lateral slopes each occupied by about eight rather depressed costæ, which are wider than the furrows between them, and sometimes, though rarely, bifurcate. Dorsal valve with beak strongly incurved; mesial fold scarcely defined, excepting at the front, where it is flat, and ornamented by about six much depressed costæ, which coalesce so as to reduce the number to three before reaching the beak; lateral slopes each occupied by about eight to ten rather broader, depressed, and sometimes bifurcating costæ, as in the other valve. Surface of both valves, when well preserved, showing very fine, obscure, crowded, and undulating striæ of growth, and everywhere covered with closely and very regularly arranged granules, not generally readily seen without the aid of a magnifier.

Length, 1.90 inches; breadth, 2 inches; convexity, 1.30 inches.

This fine species may be compared with *S. bisulcatus* of Sowerby, some varieties of which (especially those with broad depressed costæ) it more or less nearly resembles. It seems, however, to be always longer in proportion to breadth, and is much less variable in form. The most reliable difference observable, however, is the beautifully-granulated surface of our species. I know of no nearly similar American shell with which it is necessary to compare it.

Locality and position.—Light-colored Carboniferous limestone, at latitude 40° N., longitude 115° 20' W.; Colonel Simpson's collections.

SPIRIFER (TRIGONOTRETA) CAMERATUS, Morton.

Plate 9, figs. 2, 2 a.

Spirifer cameratus, Morton (1836), Am. Jour. Sci. and Arts, XXIX, 150, pl. 2, fig. 3.—Hall (1856), Pacific R. R. Report, III, 102, pl. 2, figs. 9, 12, and 13; and (1858) in Iowa Geological Report, I, part ii, 709, pl. xxviii, fig. 2.—Meek (1876), in Col. Simpson's Report Expl. across the Great Basin of Utah, 353, pl. ii, figs. 3 a, b.

Spirifer Meusebachanus, Roemer (1852), Kreid. von Texas, 88, pl. 11, figs. 7 a, b, c.

Spirifer triplicatus, Hall (1852), Stansbury's Report of Salt Lake Expl. Expedition, 410, pl. 2, fig. 5 (by error pl. 4).

? *Spirifer fasciger*, Owen (1852), Report Wisconsin Iowa and Minnesota, pl. 5, fig. 4 (Keyserling? (1846.))

Spirifer striatus var. *triplicatus*, Marcou (1858), Geol. N. Am., 49, pl. vii, fig. 3.

Spirifer cameratus var. *Kansasensis*, Swallow (1867), Trans. Saint Louis Acad. Sci., II.

? *Spirifera camerata*, Derby (1874), Bull. Cornell Univ., I, No. ii, 13, pl. i, figs. 1-9, and 14.

The specimens that I have referred to this common species are all more or less broken or distorted; but, so far as their characters can be made out, they seem to agree so nearly with characteristic examples of Morton's species from the Coal-Measures of the Mississippi Valley, that I have scarcely any doubts of their identity. They all have the peculiar fasciculated character of the costæ, so characteristic of *S. cameratus*, more or less marked, while in some of them it is well defined. They seem to have the mesial fold somewhat less prominent, and the lateral slopes less compressed than we usually see in *S. cameratus*; but these are more or less variable characters in that species.

Locality and position.—Light-colored Carboniferous limestone, at Fos-

sil Hill, White Pine District; also from same in the Ruby Group, Nevada. Colonel Simpson likewise brought specimens of it from latitude $39^{\circ} 33' N$, longitude $115^{\circ} 12' W.$, where it seems to be quite abundant in the same limestone.

LAMELLIBRANCHIATA.

PTERIIDÆ.

? Genus POSIDONOMYA, Bronn.

POSIDONOMYA ? FRAGOSA, Meek.

Plate 3, figs. 8, 8 a.

Shell subovate, compressed, more or less oblique, very thin and fragile; hinge short and apparently varying much in its obliquity to the longer axis of the valves; beaks apparently nearly terminal; posterior basal margin rounded. Surface with irregular concentric undulations and striæ, usually most distinct on the central region, where they are often crossed by faintly-defined radiating costæ, which sometimes extend nearly to the posterior basal margin.

Length of one of the largest specimens seen, measuring obliquely in the direction of the longer axis of the valves, 1.10 inches; breadth at right angles to the same, about 0.80 inch.

As the specimens of this shell in the collection (or at least all that remains of the shell) are extremely thin and fragile, and flattened between the laminae of the shale, as well as otherwise distorted, it is quite probable that it may be found necessary to modify some of the characters given in the above diagnosis of the species. Until better specimens can be obtained for examination, its generic affinities must also remain doubtful, though I am inclined to think it belongs to some genus at least allied to *Posidonomya* of Bronn, and including a species I have described from the Coal-Measures of Ohio under the name *Posidonomya fracta*; which latter also occurs in the Coal-Measures of Illinois.

[As these pages are going through the press, I observe that Professor Hall and Mr. Whitfield, who have prepared a supplementary report on Mr. King's later collections, have referred this shell to *Lunulicardium* of Münster (see Am. Jour. Sci. and Arts, vol. XI, p. 479, where the name is,

by a typographical error, printed *Linulicardia*). As stated in the foregoing remarks, the specimens examined by me are flattened between the laminæ of shale, and therefore in a very unfavorable condition for satisfactory generic determination. I have not seen them since writing the foregoing description, six years back; and the old work in which Münster described the genus *Lunulicardium* is one of the very few publications of the kind that I have never yet been able to consult. If I am correctly informed, the hinge of *Lunulicardium* is unknown, and it is very improbable that any specimens of the shell here under consideration showing the hinge have yet been found. From the impressions of its general physiognomy, however, left on my mind, it would seem to differ much from the general external characters of *Lunulicardium excrescens*, Münster, which is the species generally figured as an illustrative example of the genus. That it is certainly a *Posidonomya*, however, I have never asserted.]

Locality and position.—White Pine Mountains near Hamilton, Nevada; from a black laminated shale of Devonian or Carboniferous age.

Genus AVICULOPECTEN, McCoy.

AVICULOPECTEN CATACTUS, Meek.

Plate 3, figs. 10, 10 a (and 10 b ?).

Shell rather under medium size, much compressed, very thin and having scarcely any degree of obliquity—exclusive of the ears, subovate in outline; hinge-margin less than the greatest breadth; posterior and anterior margins rounding into the regularly-rounded base. Left valve compressed-convex; ears nearly flat; the posterior one not distinctly separated from the swell of the umbo, about as long as the margin below, from which it is separated by a broad, more or less rounded, moderately deep sinus, which imparts a rather acute angularity to its posterior extremity; anterior ear a little declining, with its anterior margin slightly convex in outline, but terminating nearly in a right angle above, and defined below by a rather shallow, obtusely angular sinus; beak slightly nearer the anterior side, projecting a little above the hinge, and incurved, but not oblique. Right valve nearly flat, and having the same general outline as the other, excepting that its beak is much less distinct from the hinge-margin, and the sinus

under the anterior ear is very deep, sharply defined, narrow, and directed obliquely backward toward the beak. Surface of left valve ornamented by small, generally simple, depressed, radiating costæ, between each two of which there is one, or on some parts two or three, smaller linear ribs, that usually die out before reaching the beaks; while small concentric wrinkles are also usually more or less defined on the body-portion of the valve, so as to impart a faintly tubercular appearance to the costæ at the points where they cross; radiating costæ on the ears, merely small raised lines, rather distantly separated, and crossed at regular intervals by little sharply-elevated lines, parallel to the free borders, so as to produce a more or less cancellated style of ornamentation. Surface of right valve (fig. 10*b*) with radiating costæ (excepting one separating the posterior ear from the body of the valve, and those on the anterior ear, which are larger than the others) all small, and of nearly uniform size. Lines of growth very minute and obscure on both valves; though the right valve has some strong concentric furrows.

Height of one of the largest specimens, 0.88 inch; breadth of the same, 0.89 inch; length of hinge-line, 0.64 inch.

This species is evidently allied to *Aviculopecten occidentalis* (= *Pecten occidentalis*, Shumard, = *P. Cleavelandicus*, Swallow), a very common and widely-distributed species in the Coal-Measures of the Mississippi Valley. It is a much thinner and more compressed shell, however, and always without any traces of the subimbricating concentric lamellæ of growth, generally seen on well-preserved left valves of that species, and sometimes even rising as little vaulted scales on the costæ, especially on those of the anterior ear and near it. From *A. Lyelli* of Dawson, described from the Lower Carboniferous rocks of Nova Scotia (which I am much inclined to think not distinct from *A. occidentalis*, Shumard), it differs in the same characters distinguishing it from the latter. Compared with *A. rectilaterarius* of Cox (sp.), it will be seen to differ not only in its deeply sinuous posterior margin, and the consequent acutely angular character of its posterior ear, but in having two sets of costæ; that is, a larger and a smaller set, generally alternating. It is probably most nearly allied to *A. Coxanus*, Meek and Worthen, from the Coal-Measures of Illinois; with which

it agrees in its extreme thinness as well as in general appearance. It, however, attains a larger size, and has proportionally larger costæ; while its surface does not show, under a magnifier, the fine, regular, and distinct striæ of growth seen on that species.

Among foreign species, it seems to be most nearly represented by *Aviculopecten papyraceus*, Sowerby (sp.); which, however, is a much larger, more oblique shell, with very differently formed ears, as illustrated by Sowerby. In the form of its posterior ear, as well as in some other characters, it agrees more nearly with a shell from the Coal-Measures of Belgium, figured by Professor De Koninck (An. Fos. Belg., plate v, figs. 6 *a*, *b*), and by him referred to *A. papyraceus*, Sowerby; though it differs materially in other respects. If the figures published by Sowerby and De Koninck, of the forms illustrated by them under the name *Avicula papyracea*, are exactly correct, I should think they represent two distinct species. At least, none of our analogous species in this country present, among hundreds of individuals, such marked differences as are seen between their published figures.

Locality and position.—From a black bituminous shale at Hamilton, White Pine Mountains, Nevada; of Devonian or Carboniferous age.

AVICULOPECTEN UTAHENSIS, Meek.

Plate 9, figs. 7, 7 *a*, 7 *b* (and 7 *c*, *d*?).

Pecten Utahensis, Meek (1860), Proceed. Acad. Nat. Sci. Philad., XII, 310.

Aviculopecten Utahensis, Meek (1876), in Col. Simpson's Report Expl. across the Great Basin of Utah, 354, pl. i, figs. 9 *a*, 9 *b*.

Shell of about medium size, suborbicular, compressed, thin, not oblique; hinge-line straight, equaling about one-half to two-thirds the antero-posterior diameter of the valves; pallial margin regularly rounded. Left valve compressed, or moderately convex; ears rather small, flattened so as to be more or less distinct from the slight convexity of the umbo, each separated from the margin by a shallow, obtusely angular notch, of which the one under the anterior ear is rather more distinctly defined; anterior ear nearly rectangular at the extremity, with a slightly convex anterior margin; posterior ear generally more obliquely truncated; beak small, rather compressed, not projecting above the hinge, and placed at or slightly in advance of the middle of the cardinal margin, with its lateral slopes diverging at an

angle of about 95° ; surface ornamented by rather obscure, unequal, radiating costæ, and numerous, very regular, extremely fine, concentric striæ, scarcely visible without the aid of a magnifier; costæ not defined on the ears, or usually on the adjacent lateral margins, and most frequently arranged with from one to three smaller ones between each two of the largest, the middle one of the three smaller being sometimes a little larger than the smallest one on each side. Right valve as convex as the other, or sometimes more compressed, but without traces of radiating costæ or striæ; ears of the same size, and nearly of the same form as in the other valve, excepting that the anterior one is defined by a deeper marginal notch.

Length, or antero-posterior diameter of a large specimen, 1.70 inches; height of the same, 1.73 inches; convexity of left valve, 0.25 inch.

I am not *positively* sure that the two valves described above belong to the same species, not having seen them in any instance united. The fact, however, that they occur together in the same matrix, and have the same form, and do not differ very greatly in size, while the smooth specimens are all right valves, and the costated ones left valves, leaves little room for doubting that they are the opposite valves of the same species. The most obvious characters of this shell are its nearly circular form, subequal ears, and the very fine, regular, concentric striæ, and unequal radiating costæ of its left valve. I know of no other species nearly enough allied to render a comparison necessary.

The form to which the costate valves belong may be considered the type of the species, in case the smooth valves should prove to belong to a different shell.

Locality and position.—In light-colored Carboniferous limestone, at latitude $39^{\circ} 33' N.$, longitude $115^{\circ} 12' W.$; Colonel Simpson's collection.

AVICULOPECTEN OCCIDANEUS, Meek.

Plate 12, figs. 13, 13 a, 13 b.

Shell small, usually very little oblique, broad ovate-suborbicular in outline exclusive of the ears; hinge shorter than the antero-posterior diameter; pallial margin more or less regularly rounded, but generally a little more prominent behind the middle than before. Left valve moderately convex;

beak pointed, convex, nearly central, projecting slightly beyond the hinge-margin, and somewhat incurved; ears nearly equal, compressed; the anterior one, which is nearly rectangular at the extremity, generally separated from the swell of the umbo by a broad, rather deeper concavity, which is continued to the margin, to which it imparts a slight sinuosity under the ear; posterior ear a little larger than the other, but not extending back as far as the margin of the valve below, in some examples apparently less than rectangular at the extremity, and in others more, in consequence of the more or less sinuous character of the margin. Surface ornamented by small, raised, simple, radiating costæ, or striæ, about every fourth to every seventh one of which (especially on the body-part) is a little larger and more prominent than the others; while those on the ears, particularly on the anterior one, are all smaller, though they are generally well defined on both ears; a few very small, irregular, concentric marks of growth may also sometimes be seen crossing the surface of the body-part of the valve. Right valve not certainly known.

Height of one of the medium-sized specimens of a left valve, 0.44 inch; breadth, 0.37 inch; convexity, 0.10 inch.

I am not sure that I have seen any right valves of this species. There are among the specimens some imperfect examples that would seem, from the direction of the very slight obliquity, to be right valves. But owing to the fact that they are generally quite as convex as others that are certainly left valves, and have exactly the same surface-markings, while the ears, as nearly as their form can be made out, would also indicate that they are left valves somewhat distorted so as to change their slight obliquity, I am led to regard them as such. The most characteristic features of the species are its rather small size, nearly equal ears, and small radiating costæ, always increasing by intercalation, with every fourth, fifth, sixth, or seventh one on the body of the valves (at least the left one) a little larger and more prominent than the others.

The reason why this and some other Carboniferous and possibly some Jurassic forms are figured together on the lower half of plate 12 is elsewhere explained. (See note on explanations of plate 12.)

Locality and position.—Weber Cañon, Wasatch Range; Upper Coal-Measure limestone.

CEPHALOPODA.

GONIATITIDÆ.

Genus GONIATITES, De Haan.

GONIATITES GONIOLOBUS, Meek.

Plate 9, figs. 5, 5 *a*, 5 *b*.

Shell distinctly discoid, with (in internal casts) a narrowly-rounded periphery; volutions compressed laterally, with slightly convex sides, the greatest convexity being a little within the middle; about twice as wide in the dorso-ventral diameter as at right angles to the same; each turn embracing all the others, so as to leave only a very small umbilicus, showing none of the inner volutions. Septa closely and very regularly arranged, but nowhere in contact or lapping upon each other; siphonal lobe (generally called the dorsal lobe) very large, and profoundly divided into two large, elongated, acutely-pointed terminal branches, which lap so far over each side of the volutions as to appear each like a large lateral lobe; while between these there is a third minute central projection; first lateral sinus very deep, elongate-conical, very acutely angular at the extremity, and arched or obliquely curved toward the umbilical side; second lateral lobe of much the same form as the divisions of the siphonal lobe, but a little shorter; second lateral sinus wider than the lateral lobe, but more shallow, and merely forming a broad forward arch to the umbilicus. Surface of internal cast without nodes, costæ, or angles.

Greatest diameter of a specimen, with the body-chamber broken away, 3.07 inches; convexity, 0.87 inch; breadth of outer volution, measuring in the direction of the plane of the shell, 1.72 inches.

Excepting in being more compressed, with a more narrowly rounded periphery, this species has much the general appearance externally of *G. rotatorius*, De Koninck. Its septa are more closely approximated, however, and differ remarkably in having the siphonal lobe so enormously developed, and so wide and deeply divided as to lap over on the sides far enough to cause its large, acutely-pointed terminal branch on each side, to appear, in a side-view, like a first lateral lobe; while the first lateral lobe is thus, as it were, crowded much farther inward, and appears like a second lateral lobe.

From this structure, each side of the fossil looks very much as if there were two large, sharply-angular lateral lobes, where there is really only one.*

The only specimen of this species I have seen belongs to the Museum of the General Land-Office at Washington. It is an internal cast, composed of a deep brownish-red oxyd of iron, but shows all the characters of the species, excepting the surface-markings (if there were any), very clearly.

Locality and position.—It is only known that the specimen came from New Mexico. From its affinities, it would seem to be of Carboniferous age.

UPPER TRIASSIC SPECIES.

MOLLUSCA.

BRACHIOPODA.

DISCINIDÆ.

Genus DISCINA, Lamarck.

DISCINA, sp. undetermined.

Plate 10, figs. 3, 3 a.

I only know this shell from two specimens of the under valve, and these show only the inner side. They have a subcircular or broad subovate outline, being slightly narrower posteriorly than in front. The anterior

* The contrast in the structure of the septa of the typical *Goniatites*, such as *G. sphaericus*, De Haan, and the species here described, with their deep, acutely angular lateral lobes, and those older species, such as *G. expansus* or *Marsellensis*, Vanuxem, with the septa making merely a broad backward curve across each side, without any lateral lobes, is very striking. It may therefore be convenient to separate these more simple types (the *Nautilini* of authors) as a distinct subgenus on this structure of the septa and other characters. I would therefore propose for this group the subgeneric name *Agoniatites*, with *Goniatites* [*Agoniatites*] *expansus*, or *Marsellensis*, of Vanuxem, as the type. It is probable, however, that there are, among the known species with this simple structure of the septa, forms that might be properly separated from the group including *G. expansus* on other characters, as that species presents some striking peculiarities in its development, the young having its periphery rounded with a double groove and a ridge between, and the sides marked with arching undulations, while in the adult, the undulations become obsolete, and the periphery flattened, with distinct angles. *G. Bohemicus* of Barrande belongs to this group.

central region is concave on the inside, and the posterior convex and pierced by the fissure, which is rather short, with its inner end about equidistant from the posterior margin and from the middle of the valve; though its inner end terminates at the center of growth, as may be seen by the concentric arrangement of the fine obscure striae of growth observable on the interior.

Antero-posterior diameter, 0.62 inch; breadth, 0.58 inch.

The species of this genus are so difficult to distinguish without a good series of specimens, that I have been unable to satisfy myself that this is new, or to identify it with any known species, and therefore merely give a figure of it, as one of the forms found in the rocks at the locality mentioned below. If new, however, it may be called *D. Utahensis*.

Locality and position.—Weber Cañon, Wasatch Range; Triassic.

LAMELLIBRANCHIATA.

PTERIIDÆ.

Genus HALOBIA, Bronn.

HALOBIA (DAONELLA) LOMMELI, Wissmann.

Plate 10, fig 5.

Halobia Lommeli, Wissmann (1841), Beitr. Petref., IV. Heft, 22, tab. 16, fig. 11.—

Horness (1855), Densk. Kais. Akad. Wissensch., IX, 52, taf. ii, fig. 17.—

Zittel, Fossile Moll. und Echinodermen aus Neu-Seeland, 27, taf. vi, figs.

1 a, b, c.—Stoliczka (1866), Mem. Geol. Survey India, V, 44.

Avicula pectiniformis, Catullo (1847), Prodr. Pal. Alpi Ven., 73, pl. i, figs. 1, 2, 3.

Posidonomya Lommeli, d'Orbigny (1849), Prodr. de Paléont. Stratigr. Univ., I, 201.

? *Halobia ? dubia*, Gabb (1864), Geol. Survey California, I (Palæont.), 30, pl. 5, figs.

28 a, b.

Daonella dubia, Mojsisovics (1874), Ueber die Trasch. Pelicyp.-Gatt. Daonella und *Halobia*, 22.

Shell truncato-subcircular, very much compressed, and very slightly oblique, nearly or quite equivalve, and but slightly inequilateral, the anterior side being a little shorter than the other; hinge somewhat shorter than the valves; anterior and posterior margins intersecting the hinge at obtuse angles, the latter more obliquely than the other, both rounding into the more or less regularly rounded base; posterior basal margin more prominent than the anterior; beaks very small and inconspicuous, with their

small abruptly-pointed apices scarcely projecting above the hinge and turned slightly forward. Surface marked off, as it were, into more or less wide, irregular, flat radiating costæ, by much narrower or merely linear furrows, the ribs themselves being sometimes also more or less subdivided by much finer furrows; ribs often obsolete near the hinge, both before and behind the beaks, but sometimes one or both of these spaces are occupied by fine irregular costæ; a few very faint concentric marks of growth also usually occur near the beaks.

Length of large specimens, apparently about 2.30 inches; height, about 1.60 inches.

Although this shell seems to have been quite abundant, none of the specimens contained in the collection show the entire outline, though its general form can be pretty nearly inferred from the faint undulations of growth. It is possible that a comparison of specimens might show this shell to be distinct, but I have been unable to find any greater differences, even in the most unimportant details, between these specimens and the figures of the European form, than I observe among the specimens themselves, and between the figures of *H. Lommeli*, published by different authors.

I see Professor Mojsisovics refers *Halobia Lommeli* of Wissmann, and *H. dubia*, Gabb, to his newly-proposed genus *Daonella*. I am not very well acquainted with the type-species of Bronn's genus *Halobia*; his figured specimen, as well as those illustrated by Professor Mojsisovics, being quite imperfect. If I can be permitted to judge, however, from the figures of several other species referred to *Halobia* and *Daonella* by Professor Mojsisovics, there would seem to be such a series of intermediate gradations between these two groups as to leave the impression that they are hardly more than subgenerically distinct, if even that. The only difference seems to be that in the typical species of *Daonella* (*D. Moussoni*) the lateral margins round into the straight dorsal border, while in the species referred by Professor Mojsisovics to *Halobia*, they meet the straight dorsal edge at more or less obtuse angles; and on the anterior side the cardinal margin is compressed, or has an oblique furrow, indicating a slight tendency to form an obscure anterior auricle, defined by the faintest possible indication of a marginal sinus. With these exceptions, the diagnoses of the two groups are precisely the same.

Locality and position.—West of New Pass Mines, Desatoya Mountains, Cottonwood Cañon, West Humboldt Range, Nevada.

LUCINIDÆ.

Genus SPHÆRA, Sowerby.

SPHÆRA WHITNEYI, Meek.

Plate 10, figs. 4, 4 a, 4 b, 4 c.

Shell subcircular, almost exactly equilateral, rather convex, basal, anterior, and posterior margins forming together a regular semicircular curve; dorsal margin somewhat straightened and nearly horizontal, or apparently sometimes sloping slightly from the beaks, rounding rather abruptly into the anterior and less distinctly so into the posterior margins; beaks rather depressed, or moderately prominent, obtuse, nearly central, and without visible general obliquity, but with the incurved immediate points directed a little obliquely forward; surface only showing obscure lines of growth.

Length of largest specimen seen, 1.65 inches; height, 1.54 inches; convexity, 0.86 inch.

None of the specimens of this shell give any clew to the nature of its hinge or interior; but, from its general external characters, I am led to refer it to *Sphæra*, though I am aware that it might, so far as can be seen, with almost equal propriety be referred to *Unicardium*, or any one of several other genera. Some varieties of it resemble *Lucina anceps* of Laube (see Fauna der Sch. von St. Cassian, taf. xv, figs. 4, 4 a); but it is evidently not a *Lucina*. It also differs in attaining a much larger size, and in wanting the peculiar sinuous character of the anterior ventral margin, so distinctly marked in Laube's shell.

It is possible that our largest specimen represented by fig. 4 c may be a distinct species from the smaller typical forms represented by figs. 4 and 4 a.

Locality and position.—Buena Vista Cañon, West Humboldt Range, Nevada; Upper Trias.

MYTILIDÆ.

? Genus MODIOMORPHA, H. & W.

MODIOMORPHA ? OVATA, Meek.

Plate 10, figs. 1 and 1 a.

Shell obliquely ovate, much compressed; posterior side wider than the anterior, and broadly rounded in outline; anterior margin narrowly rounded above and sloping backward below; base prominently rounded behind the middle, rounding regularly into the posterior outline, and sloping up anteriorly from behind the middle, with some appearance of being slightly gaping in advance of the middle; cardinal border shorter than the valves, and passing, by more or less gradual curves, into the anterior and posterior margins, ranging obliquely to the longer axis of the shell; beaks depressed nearly upon a line with the hinge-margin before and behind them, compressed and located about one-third the length of the valves from the anterior extremity. Surface showing only moderately distinct concentric lines, with sometimes very obscure undulations of growth. (Hinge and interior unknown.)

The specimens of this shell in the collection are all right valves, and have the anterior ventral margin bent inward a little, so that if the other valve presented the same character the lower margin, somewhat in front of the middle, must have been more or less gaping. Without seeing its hinge and interior, we can only guess at its affinities. In general appearance, it reminds one of some of the broad compressed species of *Modiolopsis* from the Silurian; but it is apparently as nearly like some of the species included in the new Devonian and Carboniferous genus *Modiomorpha*. That it really belongs to either of these genera, however, is at least improbable, and the chances are in favor of the conclusion that it will be found to belong to an undescribed genus. If so, I would propose for it the name *Modiolina*.

Locality and position.—North fork of Buena Vista Cañon, West Humboldt Range; Upper Trias.

MODIOMORPHA ? LATA, Meek.

Plate 10, fig. 2.

Shell transversely ovate, moderately convex in the central and umbonal regions, and compressed behind; posterior side distinctly wider than the

anterior, rather broadly and regularly rounded in outline; base semi-ovate, being more prominent behind, where it rounds up regularly into the posterior margin, while it is somewhat straightened and sloping up gradually forward; anterior end short, and truncated a little obliquely forward above from the beaks to the anterior basal extremity, which is abruptly rounded or subangular in outline; hinge-margin straight, about half as long as the shell, and rounding into the posterior margin behind, but not extending forward beyond the beaks, which are slightly tumid, obtuse, depressed, and located only about one-fifth the length of the shell from the anterior extremity. Surface showing obscure lines of growth. (Hinge and anterior unknown.)

Length, 1.30 inches; height, 0.95 inch; convexity (of left valve only), 0.20 inch.

Judging from external appearances only, this shell seems to be congeneric with the last; but, as nothing is known of the nature of its hinge and internal characters, I am equally in the dark in regard to its affinities. As it resembles some of the forms included in the genera *Modiomorpha*, I have referred it provisionally to that group, until its generic characters can be determined. It is a more convex shell than the last, and also differs in having its anterior end obliquely truncated above, instead of being extended, rounded, and compressed in front of the beaks.

Locality and position.—Same as last.

CEPHALOPODA.

ORTHOCERATITIDÆ.

Genus ORTHOCERAS, Auct.

ORTHOCERAS BLAKEI, Gabb?

Plate 10, fig. 11.

Orthoceras Blakei, Gabb (1864), Geol. Survey of California, I (Palæont.), 19, fig. 1.

The specimens here referred doubtfully to the above species consist merely of two fragments, one of which seems to have belonged toward the posterior part of the shell, though not showing the septa, and the other is a part of the body-chamber. The first is gradually tapering, with a circular

section, and the other seems to have been almost exactly cylindrical, and is somewhat compressed, though evidently by accidental pressure. It also shows some appearances of a slight constriction at the aperture, and has, in the cast, a raised line along the ventral side, as we often see in palæozoic species. As there are no appearances of septa, I have sometimes suspected that it may possibly be the cast of a Belemnite; but it seems not to be.

Not having had an opportunity to compare good specimens of *O. Blakei* with European species from the same horizon, I have formed no opinion in regard to its relations to the latter, and merely refer the form under consideration doubtfully to Mr. Gabb's species, because it came from the same region and the same geological position; while the specimens present no characters inconsistent with the conclusion that they belong to the species described by Mr. Gabb.

Locality and position.—Ridge above Cottonwood Cañon, West Humboldt Range; Upper Trias.

AMMONITOID FORMS OF THE UPPER TRIAS OF NEVADA.

In examining the shells of the above-mentioned types, in Mr. King's collection from the Upper Trias, or possibly in part from the Lower Lias of Nevada, it soon became evident that none of them would fall properly into the genus *Ammonites* as the latest methods of classification will require that group to be restricted. It was also equally manifest that the same principles of generic limitation would require the establishment of new genera for the reception of some of the species. Having neither the necessary material at hand, nor the time nor inclination, merely for the classification of a few species, to enter upon the study and revision of the whole group of Triassic and Liassic Ammonitoid types, I proposed, after separating and writing out full descriptions of the species, to send the specimens to Professor Hyatt (who has long made an especial study of these older forms of this great group of extinct Molluscs), with the view of having them compared with the splendid series of European forms in the Cambridge Museum of Comparative Zoölogy; the understanding being that he should name and describe the new genera, and that I should describe the species and refer

them to the same. To this Professor Hyatt kindly assented, and I now give his descriptions of the new genera, and remarks on some of the species; placing his initials (A. H.), wherever quotations are made from his manuscript.

I should remark, however, that I had already identified among the specimens, the following genera, viz., *Trachyceras*, *Clydonites*, and *Arcestes*, and referred the species to forms figured and described by Mr. Gabb in the Palæontology of California, ranging them under the above-mentioned genera.

It would be superfluous for me to attempt the expression here of any opinion of my own in regard to the propriety of the subdivision of the old genus *Ammonites* into such a great number of genera, and even families, as is done in the new classifications, since I have never made an especial study of this extensive group of shells with the view of forming an opinion on this point. I can therefore only say that Professor Hyatt's conclusions have not been lightly adopted; but that he has, on the contrary, devoted much time and patient research to the study of one of the most extensive and complete collections of this group of shells in the world.

It may be proper for me to explain here some differences of terminology that will be observed in Professor Hyatt's and my own descriptions and remarks. For instance, he very properly describes the external margin, or outer side of the volutions in the Ammonitoid types, as the *abdomen*, and the inner as the *dorsum*; while I have used the term *periphery* for the former, and *umbilical* or *inner side* for the latter. His method has the advantage of properly expressing the true relations of the animal and its shell; though I have rather preferred the terms I have used, because they avoid the perplexing confusion of ideas liable to arise in the minds of those who have become familiar with the (until recently) prevalent method of describing the outer side as the *dorsal*, and the inner as the *ventral*, as we see in nearly all the published works on such shells. Again, in the same way, he terms the outer lobe of each septum the *abdominal lobe*; while I have for the same used the term *siphonal lobe*, already in use by some European authors. The lateral lobes and intervening sinuses of the septa I have merely numbered consecutively *first*, *second*, *third*, and so on, from the outer one inward, instead of using

von Buch's terms *superior-lateral*, *lateral*, *inferior-lateral*, and *auxiliary lobes* and *saddles*. The former method seems to me more simple, and enables one to refer very precisely and directly to any particular lobe or sinus, whether there be few or many. For the ridges crossing the volutions, Professor Hyatt uses the term *pilæ*; while I have used for the same the old term *costæ*.

I am not, however, objecting to Professor Hyatt's terminology, which is very good, but merely explaining the different terms we have here and elsewhere used for the same parts of the shell.

"CLYDONITIDÆ.*

"Genus COROCERAS, Hyatt.

"(κάρυς, a helmet; κερας, a horn.)

"*Ammonites*, *Goniatites*, *Aganides*, &c. (sp.), of several authors, but not as those genera are now restricted.

"*Clydonites* (pars), Hauer (1860), Sitzungsab. der Kais. Akad. Wiss., XLI, 122.—Laube (1869), Fauna St. Cass., 14.

"This genus comprises the following species, viz., *Clydonites delphinocephalus*, *C. ellipticus*, Hauer, and *C. nautilus* and *C. monilis*, Laube; the latter being viewed as the type. These species all have numerous lobes and cells, with smooth sutures, and a large abdominal lobe; the latter being very broad and prominent. They are pileately ribbed and very involute; the umbilicus nearly covered. The mouth is more or less hooded or constricted. These are the only members of the group that can be satisfactorily characterized. The remaining species originally included in *Clydonites* are very distinct from the typical forms and from each other, and may be arranged into the following groups:

"1.—*Clydonites geniculatus*, *C. glaucus*, and *C. Eryx*, Hauer, with *C. Wissmanni*, of the same author.

"These have a similarly short clumpy abdominal lobe, with a minute siphonal cell; but otherwise they are entirely different. The whorls of the first, however, are short, with gibbous sides, subangular at the edge of the abdomen; the second, high and crowded. Those of *C. glacialis*, on the

* Professor Hyatt proposes this new family for the reception of his above described genus *Coroceras* and *Clydonites*, Hauer, with probably other genera not contained in the Nevada collections. In the same way he proposes other new families farther on.

other hand, are very flat and compressed. The lateral lobes and cells would pass for those of a typical *Clydonites*; but the latter are larger and more numerous. In both, however, the superior lateral lobes are the deepest.

"2.—*Clydonites quadrangularis* and *C. costatus*, Hauer.

"These have septa quite similar, but there is no agreement of form, the former having involuted, squarely-shaped, rapidly-increasing whorls, and the latter abdominally-depressed, non-involute, gibbous-sided, keeled whorls.

"3.—*Clydonites spinescens* and *C. armatus*, Hauer.

"These are very distinct species, the septa differing considerably, and the forms and pilæ more.

"4.—*Clydonites decoratus*, Hauer, the first species mentioned by him, and here viewed as the type of that genus, is decidedly unique in the group; the rows of tubercles on the abdomen are exceptional, although the septa, if correctly drawn, are similar to those of *C. spinescens*.

"5.—*Clydonites Fresei*, Laube, has very singular septa, quite similar to those of *Ammonites Klipteinianus*. The smoothness, stoutness, and involution of the whorls, however, in the latter are very different from the pileated non-involute whorls of the former.

"The want of proper classification and arrangement which is thus shown to exist in this natural series was very plainly perceived by its describer, who asserts that it contains different types, and is capable of division into different families.

"The confusion introduced into nomenclature of the Ammonites by von Buch, who, as a geologist, did not recognize the necessity of giving a fixed value to the names of groups, is here repeated; and the *families* are considered less comprehensive than the *genera*.

"So little is known of the septa of the American specimens that their place among the *Clydonitidæ* appears to be doubtful, though the few lateral lobes figured in the California Geological Report seem to show that they belong to this division."—(A. H.)

Genus CLYDONITES, Hauer.

CLYDONITES LÆVIDORSATUS, Hauer (sp.).

Plate 10, fig. 7.

Ammonites lævidorsatus, Hauer (1860), Sitzungsab. K. Akad. Wien, pl. 3, figs. 9 and 10 b.
Goniatites lævidorsatus, Gabb (1864), Geol. Survey of California (Palæont.), I, 21, pl. 3, figs. 6, 7.

Shell compressed-discoidal, with a very wide, exceedingly shallow umbilicus; periphery more or less narrowly rounded; volutions numerous, very slender, increasing very gradually in size, and each one enveloping about one-third to one-half of the next within; aperture as determined by sections of the volutions, emarginate-subelliptic, being more or less emarginated on the inner side for the reception of the outer side of the next turn within. Surface nearly smooth, or only obscurely ribbed in some specimens, but more generally ornamented with rather strong, regular costæ on each side, that usually curve rather strongly forward as they approach the periphery, upon which they become obsolete.

Greatest diameter of one of the largest specimens, 2.70 inches; convexity, about 0.60 inch.

I have seen no specimens of this species showing either the siphuncle or the septa, and it seems that none of those seen by Professor Hauer were in a condition to show the nature of the septa. Mr. Gabb, however, describes them as being each "composed of a dorsal and two lateral lobes, which, with the saddles, are all nearly rounded undulations". From this character of the septa and the general form of the shell, taken in connection with the age of the formation in which it occurs, it is far more probable that the "gullet" of its siphuncle will be found to agree with that of Professor Hauer's genus *Clydonites* than with that of *Goniatites*.

As remarked by Mr. Gabb, this shell varies considerably in its surface-characters, some individuals being nearly smooth, while others have the costæ of the sides well developed. There are also some differences in the size and the arrangement of the costæ, which are sometimes proportionally wider and more widely separated than in other examples, while the periphery is more narrowly rounded in some individuals than in others.

I have had no opportunity to compare this shell with typical foreign

examples of the species *C. lævidorsatus*, but merely follow Mr. Gabb in referring it to that form from the general resemblance to Professor Hauer's figures.

After I had written the above, and referred this species to *C. lævidorsatus*, Hauer, Professor Hyatt sent me the following remarks in regard to this species, which are worthy of quotation here, because they were drawn up by him after making direct comparison with authentic European specimens of Dr. Hauer's species:

"Gabb's figures and descriptions agree well with the Nevada specimens in the collection, and his figure of the septa shows that the species probably belongs to *Clydonites*. The agreement with Hauer's figure is not so exact on account of the want of due exactness by which the pilæ are made to cross the abdomen in his figure, whereas in the specimens it is a characteristic of late production.

"Gabb especially states that in none of the specimens examined by him did the pilæ cross the abdomen. Hauer alludes to the need of a strong side-light, in order to detect them in his specimens. This is by no means the case with the two full-grown Nevada specimens under consideration, the abdominal pilæ being very prominent in both. The young correspond to the description alluded to in the California Report, which seems to have been taken from a young specimen. The first of the adult stage of development corresponds to Hauer's description, and a further development of the abdominal pilæ introduces the full-grown adult. All of these stages are easily traceable; and the one very large specimen mentioned in the California Report belonging to this species which did not have the abdominal pilæ must have been an old specimen. In that case, it would have lost these characteristics in the regular course of senile degeneration."—(A. H.)

Locality and position.—Buena Vista Cañon, North Fork, Humboldt Range, Nevada; Upper Trias (St. Cassian beds).

"TRACHYCERATIDÆ.

"Genus GYMNOTOCERAS, Hyatt.

"(γυμνός, naked; νῶτος, back; κερας, a horn.)

"The development of *Ammonites Blakei*, Gabb, and the characters of its abdomen, separate it at once most decidedly from any species of *Tra-*

chyceras. The development generally of a keel, or, in some varieties, of a raised abdomen, over which the pilæ do not pass, shows that this is a different genus, characterized by a different mode of development. The septa are quite similar to those of *Trachyceras*; but it is very evident that in the *Trachyceratidæ* the septa cannot be looked to for generic differences. Great differences also occur in the amount of involution of the different species, and in the development of their external characters. This is shown by contrasting the species *Blakei*, *Trachyceras brevidorsatum*, or *T. Brotheus*, with the type of the genus *T. aon*.

"The forms and characteristics of the young in these three species could hardly be more different, and yet their septa are very similar. Possibly a closer study of the lobes will bring out corresponding differences; but at present it is safer to rely upon the development of external features in this family."—(A. H.)

GYMNOTOCERAS ROTELLIFORME, Meek.

Plate 10, figs. 9 and 9 a.

Shell discoid-lenticular, with periphery subangular, or very narrowly rounded; convexity only about one-fourth the greatest breadth; umbilicus very small, or scarcely more than two-fifths the breadth of the outer volution, with its nearly vertical walls meeting the lateral surface of the volution so as to form a subangular margin; whorls laterally compressed, with greatest convexity within the middle of the sides, thence converging outward with gentle convexity toward the periphery, all increasing gradually in convexity and more rapidly in breadth; each inner turn almost completely embraced in a profound sinus or concavity of the inner side of the succeeding larger one. Surface in the young ornamented with small, slightly flexuous costæ scarcely distinct from the lines of growth, but becoming apparently most defined in young shells about one inch in diameter, after which further increase in size rendered them very obscure, broader, and more distant, until they gradually died out, leaving the sides smooth, or nearly so, in a specimen two inches broad; costæ and lines of growth curving strongly forward as they approach the periphery, which the former do not cross or reach. Septa with four lateral lobes on each side, decreasing rapidly in size from the largest or first one (which is oblong, and, like the second and third,

merely digitate), to the fourth, which is very small, and nearly or quite simple; first sinus between the siphonal and first lateral lobe smaller, but of the same form as the latter, and merely obtusely serrated, while the succeeding sinuses decrease rapidly in size inward, and become more nearly simple; siphonal lobe shorter than the first lateral, but of about the same breadth, with a short, spreading, digitate, terminal, lateral branch on each side, and a few small lateral serratures along the lateral margins.

Greatest breadth of a specimen apparently, retaining most of the outer volution, 2.34 inches; convexity of same, about 0.55 inch.

In form, this shell agrees pretty nearly with some varieties of *G. Blakei*, Gabb (sp.); but it differs in being more compressed, particularly toward the periphery, which is thus made narrower, and in its more deeply embracing volutions, and consequent narrower umbilicus. Its costæ are also, apparently at all ages, excepting, perhaps, in the very young specimens, much more obscurely defined. So far as the details of the lobes and intermediate sinuses of its septa can be made out from the specimens, they seem to agree exactly with those of *G. Blakei*. I had selected for it the name *rotelliformis*, and written out a full description, with remarks on its points of difference from, and agreement with, *G. Blakei*, but was not fully satisfied whether it should be included provisionally as a marked variety of that species, or separated entirely as a distinct species. As Professor Hyatt confirms the latter conclusion, I have decided to place it apart as a different species. Professor Hyatt sent the following note respecting its relations to *G. Blakei*:

"This seems a distinct species from *G. Blakei*. The latter develops from the young, in which the pilæ are distinct, and the abdomen invariably keeled at one stage; whereas similar pilæ and a keel are only occasionally and faintly shown in the shell under consideration. The young are more distinctly pileated than the adults, and are somewhat like the young of *G. Blakei* at certain stages of growth. A close comparison, however, shows them to be flatter, and nearly the whole of each whorl is concealed by the involution of the shell, whereas *G. Blakei* has a more open umbilicus at the same age. The same remarks apply equally well to the figure of *G. Blakei* in the Palæontology of California.

"The general development and characteristics of the septa of this species,

however, resemble those of *G. Blakei*. The abdomen of the latter, however, is at first rounded, then more acute, or with a raised keel-line, and finally this disappears in a flattened abdomen."—(A. H.)

Locality and position.—Buena Vista Cañon, West Humboldt Range, Nevada; Trias.

GYMNOTOCERAS BLAKEI, Gabb (sp.).

Plate 10, figs. 10, 10 a, 10 b, 10 c; and pl. 11, figs. 6, 6 a.

Ammonites Blakei, Gabb (1864), Geol. Survey of California (Palæont.), I, 24, pl. 4, figs. 14–15.

Shell more or less compressed-discoidal, with periphery rather narrowly rounded, or subangular, in consequence of a narrow, obscure, smooth, welt-like ridge, usually seen along its middle, being sometimes more prominent in the more compressed specimens; umbilicus moderately deep, and equaling generally a little more than one-fifth the breadth; volutions six or more, more or less compressed laterally, particularly in adult specimens, but usually more rounded in the young; each enveloping one-half to three-fourths of the next within, rounding to the periphery, and truncated, or, in adult specimens, even a little overhanging around the umbilicus; aperture, as determined by sections of the volutions, subcordate, or, in compressed specimens, subhastate, with the sinus on the inner side rather deeply defined. Surface ornamented by generally distinctly-defined costæ, which, in most cases, increase by bifurcating (usually at a slightly pinched-up prominence on the larger specimens) between the umbilicus and the middle, or in part by the intercalation of others between; all curving strongly forward as they approach the periphery, where they become obsolete before reaching the faintly-marked central ridge.

Septa with siphonal lobe rather short, or about as wide as long, and divided at the extremity into two short, digitate, terminal branches, above which there are two or three very small lateral serratures. First lateral lobe, longer than the siphonal, and provided with two short, digitate terminal divisions, with some very small lateral notches above. Second lateral lobe considerably smaller than the first, but not differing very materially in other respects. Third lateral lobe still smaller than the second, and merely provided with two or three minute notches at the end; between

the latter and the suture, in the vertical wall of the umbilicus, there are two other minute, apparently simple lobes. First lateral sinus (saddle) a little wider than the siphonal, which it exceeds in length on its inner side, rounded at the end, and slightly serrated on the margins; second lateral sinus much like the first, excepting that its outer side is the longer. The other sinuses are very small, and apparently nearly simple.

Greatest diameter of the largest specimen seen, 2.20 inches; convexity, 0.70 inch. Some of the specimens are proportionally more compressed.

This is one of the most common species found in the Nevada St. Cassian beds. It seems to vary considerably in form, as well as in surface-marking; the majority of the specimens before me, however, are less compressed, and more obtuse on the periphery, than the typical specimen figured by Mr. Gabb. A few of the others, however, seem to agree more nearly with his figure, while there are so many gradations between these and the less compressed form that I am inclined to regard the whole as belonging to one species.

Mr. Gabb mentions seeing a specimen from near Star City, which he supposed belonged to this species, that was nearly six inches in diameter, and had a row of large nodes around the middle of the whorls. Adopting the conclusion that this really belongs to the species under consideration, the numerous specimens before me would seem to be all young shells, or the inner volutions of large ones, as none of them are more than two and a half inches in diameter, or show the large lateral nodes mentioned by Mr. Gabb. It is true none of them are entirely complete; but if the shell had ever attained so large a size as six inches in diameter at the locality where our specimens were obtained, there would probably have been some fragments of these large individuals brought in with the others.

As remarked by Mr. Gabb, this shell (that is the variety figured by him) resembles *Ammonites*, or more properly, I should think, *Ceratites scaphitiformis* of Hauer; but it has the peripheral ridge decidedly less prominent, and shows differences in the nature of the costæ, and particularly in the septa; which latter, in Professor Hauer's species, seem to me to present more nearly the characters of *Ceratites*.

The foregoing description and remarks were written out by me entirely

from such specimens as those represented by our figs. 10, 10 *a*, and 10 *b* on plate 10; my impression at that time being that the peculiar forms, such as that illustrated by figs. 5 and 5 *a* of plate 11, belong to an allied but distinct species, differing in the development of lateral nodes, the flattening of the periphery, and the singular elliptic or scaphitoid general outline in the adult. For this form I had proposed the specific name *scaphitoides* (*Gymnot. scaphitoides*, as the nomenclature here adopted would require). I had noticed, however, the similarity of its inner volutions to those of *G. Blakei*, and had considered the question of its possible identity with that species. But the fact that there are some ten or eleven specimens in the collection, all showing the form and flattened periphery seen in fig. 5, plate 11, while none of those that I referred to *G. Blakei*, even of equal size (as that from which were drawn figs. 10 and 10 *a* on plate 10), show any traces of the lateral nodes, flattening of the periphery, or elliptic general outline, I was led to think the former could hardly belong to *G. Blakei*.

Professor Hyatt, however, after studying the specimens carefully, arrived at the conclusion that these scaphitoid specimens with lateral nodes and flattened periphery only represent a more advanced stage in the development of *G. Blakei*. Consequently, I now yield my opinion to his greater experience and advantages in tracing the different phases of development in this order of shells, and adopt his conclusion. I prefer, however, to allow my description of *G. Blakei* to stand as originally written, and to quote below Professor Hyatt's remarks rather than rewrite my own.

The following are Professor Hyatt's notes on *G. Blakei*, and its variations and development:

"This species is smooth for the first three or four volutions. Then the pilæ begin to appear as lateral folds. During the next volution, the abdomen is smooth and broad; the whole form and mode of involution resembling *Lytoceras fimbriatum*. After this, a low, broad keel arises [see fig. 10 *a*, pl. 10], and the increase in bulk is exceedingly rapid. Intermediate pilæ [costæ] are added by folds of the shell near the abdomen on the sixth or seventh volution [see fig. 10, pl. 10]. These soon coalesce with the longer pilæ, and form more or less prominent and subsequently a tubercular junction. On the eighth or ninth whorl, the broad keel disappears, and the pilæ are wholly

forked instead of single, the tubercles at the junction very large, and the abdomen gibbous, but smooth [see figs. 6 *a*, pl. 11]. The terminations of the pilæ are at the edge of the abdomen at this stage, and show obtuse tubercles, whereas in the young they are continued over the edge of the abdomen to the base of the keel. This is the normal succession of these characters, but variations are remarkable. Besides the earlier attainment of the tubercle-shaped pilæ, there are those which never have them at all, and one specimen which becomes wholly smooth on the eighth or ninth whorl.

"Some specimens are also much flatter than others, and often the lines of growth are so decided where they cross the siphon that at first sight they may be mistaken for the pilæ themselves, but a closer examination shows that they subdivide the pilæ. These more decided striæ evidently indicate arrests of growth, and are outlines of the transient mouth. If so, there was a periodical pause in the building-up of the shell, as each pair of pilæ were about half completed.

"Another variation occurs either through compression or subsequent elliptical growth, such as is described by Barrande in *Goniatites fecundus*. By one of these means, probably the former, in eleven specimens, a *Scaphites*-like shell is produced [fig. 6, pl. 11], with broad flattened abdomen [fig. 6 *a*, same plate] and exceedingly prominent tubercles. So similar is this malformation, that I at first considered it a true Scaphitoid, bearing to *Scaphites* a relation similar to that of *Bactrites* to *Baculites*.

"There is, however, not one specimen of the eleven examined which is not more or less twisted laterally by compression."—(A. H.)

Locality and position.—Cottonwood Cañon, West Humboldt Range, Nevada; Upper Trias.

Genus TRACHYCERAS, Laube.

TRACHYCERAS WHITNEYI, Gabb (sp.).

Plate 11, figs. 3, 3 *a*.

Ammonites Whitneyi, Gabb (1864), Geol. Survey of California (Palæont.), I, 23, pl. 4, figs. 11 and 12.

Shell attaining a rather large size for a species of this group, discoid

in form, with the peripheral channel of somewhat variable depth, but usually well-defined; volutions about five, more or less flattened on the sides, rounding off a little to the periphery, and abruptly truncated, or even overhanging on the umbilical side, each enveloping about half of the next one within; umbilicus rather shallow, or of moderate depth, and less than one-third the diameter of the shell. Surface ornamented by a variable number of costæ, which curve forward as they approach the periphery, often bifurcating once or twice in crossing the sides, and also increasing by the intercalation of shorter ones between, while they usually bear on each side about four or five rows of small nodes, the most prominent of which are generally those along the margins of the peripheral furrow, and around the edge of the umbilicus; the outer rows being slightly compressed, and more or less oblique, while those on the sides of the volutions are apparently sometimes obsolescent. (Septa not observed.)

Greatest diameter of the largest specimen seen (which is imperfect), about 4 inches; convexity, 1.20 inches; diameter of umbilicus, about 1.15 inches.

The specimen from which the foregoing description and our figures were prepared, agrees much better with Mr. Gabb's fig. 12 than with his fig. 11. He was probably right, however, in including both of his figured specimens as varieties of one species, though I have not seen a series connecting the two forms. Taking the specimen represented by his fig. 12 as the typical example of the species, our shell may safely be called *T. Whitneyi*.

Among foreign species, this may be compared with *T. Archelaus*, Laube (Fauna der Sch. von St. Cassian, 5. Abth., pl. xl, fig. 1); but it differs in having its costæ more frequently bifurcating, with fewer nodes, none of which seem to be developed into spines, as in Laube's species.

After I had written the foregoing, Professor Hyatt sent me the following note respecting it:

"This species is very distinct* on account of its coarse prominent nodes and pilæ, the number of the latter, and the young, which are not unlike the young of *Gymnotoceras Blakei*. The pilæ of the young shell in

*He means distinct from *T. Judicarium*; he concurred in the opinion that it is the *T. Whitneyi*, Gabb (sp.).

T. Judicarium are finer, and the abdominal channel appears at a much earlier period of the shell's growth. The abdominal channel in this species, and others of the same genus, is preceded by a stage in which the abdomen is flat, more nearly as in the adult *G. Blakei*."—(A. H.)

Locality and position.—Cottonwood Cañon, West Humboldt Range, Nevada; Trias.

TRACHYCERAS JUDICARICUM, Mojsisovics.

Plate 11, figs. 1, 1 a.

Trachyceras Judicarium, Mojsisov. (1869), Jahrb. Geol. Reich., Wien, 133, pl. 3, fig. 4.

The specimens ranged under the above name agree so nearly with the smaller examples of *T. Whitneyi*, Gabb, that I had only separated them as a variety of that species. Professor Hyatt, however, whose facilities for making critical comparisons of this group of fossils with European forms are far superior to my own, thinks it identical with the above-mentioned foreign species. As may be seen by our figure, it seems to differ from *T. Whitneyi* chiefly in its proportionally smaller and more crowded costæ and nodes. Mr. Hyatt sent me the following note in regard to its relations to Mojsisovics' species:

"The only difference noticeable in Mojsisovics' description is that the pilæ are continuous across the abdomen, whereas in this specimen the abdominal channel is smooth. This, however, if of any more than individual value, is probably a local variation."—(A. H.)

Locality and position.—Same as last.

TRACHYCERAS JUDICARICUM, var. SUBASPERUM.

Plate 11, figs. 2, 2 a, and 2 b.

This shell agrees with the last in form, proportions, and the smallness of its costæ, but differs rather decidedly, both from that shell and *T. Whitneyi*, in having its costæ almost entirely obsolete around the middle of each side, and only a single row of rather distant prominent nodes there. It shows, however, a tendency to develop a small row around the umbilicus on each side, as in those forms, and has the usual row of oblique nodes on each side of the mesial furrow of the periphery, with another row a little farther in. At least this is the character of the single specimen of this kind in the collection, as may be seen by our figures of it on plate 11.

The specimen does not give a very clear idea of the details of the septa; but, as nearly as they can be made out, they seem to present the following characters: siphonal lobe narrow, oblong, and apparently merely provided with two small, short, simple, terminal divisions, as in *T. Whitneyi*. The sinus on each side of this is smoothly rounded, and about as wide as long, while the first lateral lobe is smaller, and also shorter than the siphonal lobe, and armed with a few digitations at the end. Between the latter and the umbilicus, there are two shallow, smoothly-rounded sinuses, and two small lobes, the first of which seems to be digitate at the end and the other smooth.

Locality and position.—Same as last.

“ARCESTIDÆ.

“Genus ARCESTES, Suess.

“*Ammonites* (sp.), Munster, Klipstein, Hauer, Giebel, Quenstedt, and others; not Brug. as restricted.

“*Arcestes*, Suess (1865), Akad. d. Wissensch., LII, 76.

“The genus *Arcestes* of Suess, like *Phylloceras* and *Lytoceras* of the same author, is a well-defined generic group. I have been justly criticised by Dr. Laube for unintentionally omitting, in my preliminary essay on the ‘Fossil Cephalopods of the Museum of Comparative Zoölogy’ at Cambridge, to give credit to Prof. Edward Suess for having been the first to suggest, in any published communication, that the Ammonites were susceptible of generic subdivision. I was, however, unacquainted at that time with Professor Suess’s results, and therefore must still continue to attribute, so far as I am concerned, the credit of the idea to Professor Agassiz, who gave me the information long before Professor Suess had published his paper.*

“Other criticisms with which I have been favored will be best answered by the memoirs now in course of publication at the Museum of Comparative

* It is well known to the writer, and many others in this country, that Professor Hyatt had long been at work on his subdivisions of the Ammonites before the publication of Professor Suess’ paper; though no one will pretend to question the fact that Professor Suess’ conclusions were independently formed, and have priority of publication.—F. B. M.

Zoölogy. I will take this opportunity, however, to say that there were peculiarities in my attempt to frame a new classification for the Ammonites which have passed unnoticed. The species were arranged in series whose affinities and genetic connections were successively traced, just as any zoölogist would trace the same relations among any disorderly mass of animals. The usual palæontological style of making genera, as if families and larger groups had no 'raison d'être'; and the genera themselves no interdependent affinities, was carefully avoided. Another peculiarity was that two of my much abused genera precisely agreed with two of those so well described in the justly-admired work of Professor Suess; and as the thirty others described independently by me were founded upon precisely the same set of differences, I find myself unable to appreciate criticisms which 'blow hot and cold' upon the same subject, according to the man, and not the man's work."—(A. H.)

ARCESTES? PERPLANUS, Meek.

Plate 11, figs. 7 and 7 a.

Shell strongly compressed, or nearly flattened-subdiscoidal, the lateral compression making the periphery so narrow as to appear almost subangular; umbilicus very shallow, and equaling about one-fourth the greatest diameter of the shell; volutions five or more, nearly flat on each side, increasing gradually in size, and each enveloping about two-thirds of the next within; aperture, as determined from a section of the whorls, very narrow at right angles to the plane of the shell, and profoundly sinuous on the inner side for the reception of the next turn within. Surface without nodes, costæ, or (on casts) visible remains of striæ. (Septa unknown.)

Greatest diameter of the largest specimen seen, 2 inches; convexity of same, 0.30 inch.

This species is chiefly distinguished by its remarkably compressed form. The only two specimens of it seen are also very slightly elliptical in outline. This latter character, however, may be due to accidental distortion; but as a similar irregularity of form exists in a number of specimens of another associated shell, and the same want of symmetry has been noticed by Professor Hauer in species from rocks of the same age in the Alps, and by Dr. Stoliczka in the Himalaya Mountains, under circumstances leading to the

conclusion that it was not due to accidental distortion, it may be natural in the form under consideration.

It is quite similar, even in its elliptic form, to a compressed variety of *A. Batteni*, Stoliczka (Mem. Geol. Survey of India, V, plate vi, figs. 1 and 1 a), figured by Dr. Stoliczka, from rocks of the same age in India. It is even more strongly compressed, however, and has a proportionally smaller umbilicus. Although it *may* possibly belong to the same species, it is far more probable that it does not. Until its septa can be seen, of course its generic relations must remain doubtful. It is not a true Ammonite, however, as the genus is restricted by the latest investigators of the fossil *Cephalopoda*, but may be placed provisionally in the genus *Arcestes* until its true relations can be determined from specimens showing the septa.

Some months after writing the above, I received the following note in regard to it from Professor Hyatt:

"This species seems to be very closely allied to *Arcestes Daonicus*, Mojs. (Jahrb. Geol. Reichsan., Wien, XIX, 136, 1869). It is smooth and has no keel, but is simply subangular on the abdomen, and has no knots on the sides, as described in *A. Daonicus*. There are certain resemblances to *Ammonites glaucus* which need comparison, and, when the septa are known, they may prove more important than would appear to be the case."—(A. H.)*

Locality and position.—Buena Vista Cañon, South Fork, West Humboldt Range; Upper Trias (St. Cassian beds).

ARCESTES GABBI, Meek.

Plate 10, figs. 6, 6 a, and 6 b.

Arcestes Ausseanus, Gabb (1864), Palæont. Cal., I, 25, pl. 3, figs. 16 and 17 (not of Hauer.)

Shell compressed-subglobose, being rounded on the periphery and convex enough on the sides to present an elliptic profile view; volutions increasing gradually in size, each so profoundly enveloping all of those within as to leave only a very contracted, deep, almost cylindrical umbil-

* On comparison with Laube's figures of *Amm. glaucus*, Munster, our shell is seen to be very similar in form, but its volutions are more embracing and more rapidly expand, while its umbilicus is consequently proportionally smaller. Of course the septa as figured by Dr. Laube, unless made out from a very young shell, would show *Amm. glaucus* to be very distinct from *Ammonites* proper.

icus; aperture, as determined from transverse sections of the volutions, compressed, crescent-shaped, being very profoundly sinuous on the inner side for the reception of the involuted turns; internal cast generally showing four subequidistant, transverse furrows to each turn, left by a thickening of the lip within at four regular periods of cessation in the growth of the shell to each volution; each of these furrows, or constrictions, bends a little backward in starting from the umbilicus, and then passes nearly straight, or with a slight backward or forward curve over the periphery. Surface generally appearing almost smooth, or only showing obscure lines of growth, with apparently sometimes the faintest possible traces of longitudinal striæ on the rounded periphery.

Septa, as made out by Mr. Gabb in the California Report (none of those I have seen show the septa), with siphonal lobe narrow-oblong, being about twice as long as wide, deeply divided into two slender, nearly parallel, bifid, and digitate terminal branches, with two or three smaller lateral branchlets on each side; first lateral lobe a little shorter than the siphonal lobe, and trifid at the extremity, with two or three lateral branchlets on each side; second lateral lobe slightly shorter than the first lateral, and similar, excepting that it is bipartite at the extremity, with the terminal divisions bifid; third lateral lobe projecting a little beyond the second, and divided more nearly like the first lateral, but otherwise somewhat smaller. Between this and the umbilicus there are two much smaller lobes, the first of which is two or three times as large as the second, and more distinctly tridigitate at the extremity. First lateral sinus smaller than the siphonal lobe, longer than wide, and tripartite at the extremity, with short lateral branchlets; second lateral sinus of much the same size and form as the first, while the three succeeding sinuses diminish rather rapidly in size toward the umbilicus, and show a more or less distinct tendency to develop similar divisions to those of the others.

Greatest diameter, 2.25 inches; convexity, 1.35 inches.

Although I thought, from sketches of this shell sent to me some years back for comparison by Mr. Gabb, that it probably could not be properly separated from *A. Ausseanus* of Hauer, a careful examination of a series of specimens reveals some differences that lead me to conclude that it is more probably only

a closely-allied representative species.* In the first place, as was noticed by Mr. Gabb, it is distinctly more compressed laterally than Professor Hauer's figures of *A. Ausseeanus*, and also differs in having the greatest convexity of the sides of its volutions much nearer the umbilicus. I am aware that these are characters in which the Ammonitoid types vary considerably, but the fact that the Nevada specimens are very constant in these characters, while there are also differences in the details of the lobes and sinuses of the septa, as made out by Professor Hauer and Mr. Gabb, leads me to suspect that still other differences would be observed if we had the means of comparing perfect specimens from the two widely-separated localities. The differences in the septa alluded to consist in the more conical form of all the lateral lobes and sinuses of the Hallstadt specimens; which also have, according to Professor Hauer's figure, the second lateral lobe distinctly tripartite, instead of bifid at the end, as represented by Mr. Gabb. There are likewise other differences in the details of the lobes and saddles, but these might be merely individual peculiarities. I lay no stress on the appearances of very faint traces of longitudinal striæ seen on some of our specimens, because others show no indications of them.

In form, and some of the characters of its septa, our shell is decidedly nearer like *Arcestes Barrandei* of Laube (Fauna der Schiebt. von St. Cassian, pl. xliii, fig. 2) than it is like the typical *A. Ausseeanus*, though it differs in having the periphery more broadly rounded, and its sides less convex in the umbilical region, while in the form and proportions of the lobes and sinuses there are differences of perhaps more importance.

Some time after the foregoing description and remarks were written, Professor Hyatt sent me the following note in regard to this species:

"It is very distinct in form from *A. Ausseeanus*, Hauer; witness its greater lateral compression, the scaphitoid or elliptical mode of growth, which is habitual; and the fact that while the adults are so different, the young are similar in their forms to the adults of *A. Ausseeanus*. I think it to be new."—(A. H.)

Locality and position.—West Humboldt Range, near Cottonwood Cañon, Nevada (St. Cassian formation).

* I had at first only separated this form here as a variety of *A. Ausseeanus*; but, with the concurrence of Professor Hyatt, I now view it as a distinct species.

"PHYSANOIDÆ.

"Genus ACROCHORDICERAS, Hyatt.

"(ἀκροχορδών, a wart; κερας, a horn.)

"This genus is closely allied to *Lytoceras* and *Phylloceras*, Suess, and *Haploceras* of Zittel, combining characteristics which are found in all of these, besides having peculiar characters of its own, and a different development. The extent of involution is comparable with that of *Haploceras*, but the whorl itself is about intermediate between the extreme roundness of *Lytoceras*, and the more flattened sides of *Phylloceras*.

"Its peculiar characteristics consist in having large lateral tubercles and abdominal pilæ, which are united as they near the tubercles. The smooth zone along the center of the abdomen in the young is also probably of generic value."—(A. H.)

ACROCHORDICERAS HYATTI, Meek.

Plate 11, figs. 5 and 5 a.

Shell discoid, with the periphery rounded; volutions rounded or very nearly so, and increasing gradually in size, with each of the inner ones about three-fourths embraced by the succeeding larger—all, so far as known, rounded on the outer side; umbilicus more than half as wide as the dorso-ventral diameter of the outer volution, rather deep, and exposing about one-fourth the breadth of each inner whorl. Surface at first in the young shell nearly or quite smooth, then ornamented with small, regular, straight, moderately distinct costæ, that seem not to cross the periphery, and die out before reaching the umbilical side, while at a later stage of growth they become quite strongly developed, especially in crossing the periphery, on which are intercalated occasional intermediate ones of equal size. These coalesce with the others on the sides of the volutions, and give origin at the points of junction to prominent nodes arranged at regularly-increasing intervals, so as to form a single row near or within the middle of each side. Protected parts also show rather distinct lines of growth, running parallel to the costæ, which latter are slightly sigmoid on the sides of the larger volutions, but pass straight across the periphery.

Greatest breadth of an imperfect entirely septate specimen, 2.82 inches; convexity of same, exclusive of the nodes, 1.15 inches

No entire specimens of this shell have yet been found; consequently we cannot be quite sure whether or not the periphery continues to be rounded and costate on the outer volution of large mature specimens, though it probably is at least rounded and less strongly costate. One distorted specimen shows that near the broken larger end of the outer volution, the costæ become less prominent and more distant, with an intermediate one between each two of the larger, the intercalated ones extending inward but a short distance from the periphery, and dying out without coalescing with the others. This part of the outer turn seems also to be nearly without lateral nodes, which, however, are well developed on the inner turns of the same specimen, where they are seen on the inner volutions just within the inner margin of the umbilicus. None of the specimens are in a condition to exhibit very clearly the details of the septa; but the one represented by our fig. 5 *a*, plate 11, shows that there are three lateral lobes on each side, the first or outer one being about one-third longer and wider than the second, with, like the latter, a few short branches or mere digitations at the end. The third or inner lobe is much smaller than the second, placed close in at the inner margin of the whorls, and apparently provided with a few short digitations.

The position of the lateral nodes, it will be observed, varies somewhat in different individuals; those on the specimen represented by fig. 4 being placed nearly out at the middle of the volutions, while on that shown by fig. 4 *a* they seem to be located farther inward. This, however, is probably, at least in part, due to the oblique distortion of this specimen.

In relation to this species, Professor Hyatt sent the following note:

"The development of this species is altogether anomalous. The whorls were evidently cylindrical and smooth for a considerable time; the increase in size being at first very slow. Large tubercles appear while the sides are still comparatively smooth in one specimen, though in another they have become completely pileated. These tubercles are from the first very prominent. Soon after the introduction of these and the pilæ, the increase in size becomes much more rapid. The resemblance of the young to *Lytoceras* is very close

at first, and the general form always remains similar. The septa are, however, very distinct; the lobes and cells, so far as they could be traced, having much more simple outlines. The pilæ do not extend across the abdomen at first, but leave a smooth band in the center. This is broken up on what is supposed to be the fifth volution by the extension of the pilæ across the abdomen."—(A. H.)

Locality and position.—New Pass, Desatoya Mountains, Nevada; Trias.

The following two types Professor Hyatt views as representing two undescribed genera, in regard to the family relations of which he has expressed no opinion. His attention was called to them after he had sent on his paper on the others; and in returning the specimens, he also sent the notes quoted below respecting them. These notes he seemed rather to regard as suggestions than as full descriptions, as he stated that I might as well go on and name and describe them myself. It seemed more proper, however, as he had investigated the whole, that these also should stand in his name. Consequently, I have selected the names, and take the liberty to insert them here on his authority, quoting his notes in regard to them.

Genus EUTOMOCERAS, Hyatt.

εὖ (augm. part.); *τομός*, sharp; *κέρας*, a horn.

"This is a well-marked type, characterized by its lenticular form, narrow umbilicus, apparently at all ages very sharp abdominal keel, without furrows or lateral ridges, and small regular arched pilæ on middle-sized specimens, growing wider, more irregular, less distinct, and developing small lateral nodes on the adult, with both nodes and pilæ becoming obsolete on the larger part of the body-volution."—(A. H.)

EUTOMOCERAS LAUBEI, Meek.

Plate 10, figs. 8 and 8 a.

Shell compressed-lenticular, with the periphery very acutely carinated; umbilicus small, or scarcely more than one-sixth the greatest diameter of the shell. Volutions much compressed laterally, with the sides gradually

converging, and slightly convex in outline, to the acutely angular periphery, on each side of which there is a very shallow undefined concavity that can hardly be called a channel, while on the inner side they are abruptly truncated or inflected, and gathered into little subnodose wrinkles at the umbilicus; each turn enveloping about four-fifths of the next one within. Aperture, as determined by transverse sections of the volutions, compressed-subhastate, being acutely angular at the outer end, and profoundly notched on the inner side, for the reception of the next turn within. Surface ornamented, in young shells of one and a half inches in diameter, by small regular costæ, that bifurcate at or near the little prominences or wrinkles at the margin of the umbilicus, after which they cross the sides and curve very strongly forward as they approach the periphery, where they become merely obsolescent lines, that are continued some distance forward almost parallel to the carina; thus indicating the probable presence of a narrow prolongation of the outer side of the lip at the aperture. A few very small, pimple-like nodes are also scattered over the inner half of the volutions at this stage of the shell's growth, while, as it increased in size, the costæ become less strongly defined and the little nodes more numerous; but farther around toward the aperture both nodes and costæ gradually fade away, until it is probable that in large shells, a part, or possibly the whole, of the surface becomes nearly or quite smooth. (Septa unknown.)

Greatest diameter of a specimen incomplete at the aperture, 1.40 inches; convexity, about 0.65 inch.

This shell has an unusually acute, unserrated, peripheral keel, which, so far as the specimen shows, seems to retain its sharpness both in the young and in the adult. The concavity on each side of this keel is very shallow, and merely so directed as to contribute to the thinness of the knife-like carina, rather than to impart any tendency to divide off another keel or even obtuse ridge on either side. The little pimple-like prominences on the sides of the volutions are almost entirely on the inner half, mainly on the little costæ, and are irregularly scattered, so as to show little or no tendency to arrange themselves in spiral rows. The obscure wrinkles or little prominences around the small umbilicus give it a somewhat puckered appearance.

This shell differs from all of the compressed, sharply-keeled ammonitoid forms known to me, with a small umbilicus and curved costæ, in the presence of the numerous little irregularly-arranged pimple-like nodes. As the specimen shows no traces of the septa, it is not possible to determine which of the numerous proposed groups it most nearly approaches in its internal characters.

The specific name is given in honor of Dr. Gustav C. Laube, of Vienna, the author of the beautiful Monograph of the St. Cassian Fossils.

Locality and position.—Same as last.

Genus EUDISCOCERAS, Hyatt.

εὖ (augm. part.); *δίσκος*, a quolt; *κέρας*, a horn.

“This type is distinguished by its discoid form, open umbilicus, and an abdominal keel, bordered by furrows and ridges, the latter being interrupted or tubercular; the young with comparatively large pilæ, growing smaller and more flexuous in the adult, and finally fading away in the larger half of the body-volution.”—(A. H.)

EUDISCOCERAS GABBI, Meek.

Plate 11, figs. 3 and 3 a.

Shell compressed-discoidal, with the periphery narrowly truncated, and having a narrow, very obscure, smooth ridge along the middle; umbilicus shallow, equaling about two-thirds the breadth of the outer turn; volutions flattened on the sides, and abruptly truncated around the umbilicus on the inner side, each embracing apparently about two-thirds of the next within. Surface with moderate-sized, rather distinct, bifurcating costæ on the sides of the volutions in young shells. As the shell advanced in growth, the costæ became smaller and more crowded, being merely coarsely linear on the outer turns, where they curve first a little backward at the umbilicus, then arch gently forward as they cross the middle of the sides, beyond which they usually curve a little backward, and then very slightly forward, as they abruptly terminate, so as to leave a narrow, smooth space between their outer ends and the narrow periphery. Around each margin of the latter there is also a row of compressed nodes arranged with their longer

axes nearly parallel to the keel of the periphery, or with but a slight obliquity, those on the opposite sides often alternating. (Septa unknown.)

Greatest diameter, 1.96 inches; breadth of umbilicus, 0.50 inch; convexity, 0.47 inch.

This form is quite unlike any of its associates, being rather peculiar in the nature of its small flexuous costæ, and the presence of a row of elongated nodes around each margin of its very narrowly truncated and keeled periphery, the nodes being arranged with their longer diameters nearly parallel to the curve of the truncated margin itself, and so disposed that those on opposite sides alternate. The ridge along the middle of its periphery is narrow, smooth, and not so defined as to be separated from the row of compressed nodes on each side by a very deep furrow.

This shell seems to be related to the St. Cassian species *Ammonites Corvarensis*, Laube, as represented by a side-view on plate xl, fig. 3, of Professor Laube's Monograph of the St. Cassian Fossils, especially in form and the nature of compressed nodes around each side of its periphery. It differs, however, in having a proportionally wider umbilicus and well-defined costæ on the sides of its volutions.

Whether Professor Laube's species has a central peripheral ridge or carina, such as is seen in our shell, cannot be determined from his figure, giving a side-view only, and he says nothing in his description on this point, doubtless because his specimen does not show the outer margin of the volutions: nor have we yet the means of making comparisons of the septa of our species with that described by Professor Laube.

The specific name of this shell is given in honor of William M. Gabb, esq., late of the California Geological Survey, and now in charge of a geological survey of Santo Domingo.

Locality and position.—Cottonwood Cañon, West Humboldt Range, Nevada; Upper Trias.

JURASSIC SPECIES.

MOLLUSCA.

LAMELLIBRANCHIATA.

LIMIDÆ.

Genus LIMA, Bruguière.

LIMA (LIMATULA) ERECTA, Meek.

Plate 12, fig. 2.

Shell, exclusive of the small ears, vertically narrow-elliptic, or about once and a half as high as the antero-posterior diameter, moderately convex, and not in the slightest degree oblique; hinge shorter than the breadth of the shell, and ranging at right angles to the vertical diameter of the valves; ears small, compressed, almost exactly equal, and obtusely angular; beaks small, nearly exactly central, and slightly incurved without any apparent obliquity. Surface marked with fine radiating lines, which seem to show some tendency to gather into a few distant larger costæ, near the narrowly-rounded basal margin; a few obscure undulations of growth are also seen crossing the striæ.

Greatest vertical diameter, 0.72 inch; breadth, or anterior-posterior diameter, 0.50 inch; convexity of one valve, about 0.10 inch.

I only know this species from a single specimen, showing none of its internal characters; and, owing to the fact that it is not in the slightest degree oblique, it is impossible to determine whether it is a right or a left valve. It is remarkable for its narrow form, equal ears, and want of obliquity. Owing to the fineness of its striæ, and the fact that they are obsolete from a little below the middle to the beak, I have been unable to see whether or not they are divaricating along the middle, as in some species of *Limatula*, though they seem not to be so from their direction below.

Locality and position.—New Pass, Desatoya Mountains, Nevada; apparently from the horizon of the Lower Lias.

PINNIDÆ.

Genus PINNA, Linnæus.

PINNA KINGII, Meek.

Plate 12, figs. 9, 9 a.

Shell attaining about a medium size, very thin, elongate-subtrigonal in general outline, apparently slightly arcuate, rather convex, with a more or less defined angle extending along the middle of each valve, so as to give the transverse section, especially at almost any point between the middle and the beaks, a rhombic subquadrangular outline, becoming more compressed posteriorly; upper and lower margins converging rather rapidly to the beaks, the first being very nearly straight, and the latter slightly convex; posterior extremity a little obliquely truncated, but rounding into the base below; valves flattened from the mesial angle to the upper and lower margins. Surface marked by fine lines of growth running parallel to the posterior and lower margins, and showing a tendency to gather into little wrinkles, particularly near the latter; while above the lateral angle they are crossed by about ten to twelve obscure radiating costæ, most distinctly defined near the beaks, and gradually becoming obsolete near the middle.

Apparently attaining a length of about 4 inches, with a height at the posterior end of about 1.90 inches; convexity, 0.85 inch.

The only specimen of this species contained in the collection is in an imperfect condition, though sufficiently well preserved to show its form and surface-markings, as well as its remarkable thinness. In form and size, it seems to have been much like *P. cancellata* of Bean (Morris and Lycett's Monogr. Moll. Great Oölite, tab. xiii, fig. 20 *a b*), from which it differs in having a mesial angle along each valve, and in having its radiating costæ obsolete on the posterior part of the valves. These costæ likewise differ in being merely obscure ridges on our shell, about as wide as the furrows between, instead of mere "knotted lines". It is, however, about as nearly allied to some imperfectly-known Carboniferous species of the Mississippi Valley.

Locality and position.—Weber Cañon, Wasatch Range; possibly Jurassic; though it may be Carboniferous, as it was found loose, and rocks be-

longing to both of these ages occur there. As elsewhere explained, the fossils on the lower half of this plate were figured together, because some doubts at first existed in regard to the exact horizons of the beds from which they came. Some of them are certainly Carboniferous; while others are more like Jurassic forms.

MYTILIDÆ.

Genus VOLSELLA, Scopoli.

VOLSELLA SCALPRUM, var. ISONEMA.

Plate 12, figs. 4, 4 a.

Modiola scalprum, Sowerby (1821), Min. Conch., III, 87, pl. 248, fig. 2.

Mytilus scalprum, Goldf. (1833), Petref. Germ., II, 174, tab. 130, fig. 9.

Shell attaining a moderate size, extremely thin, transversely elongated, or about twice and a half as long as high, gibbous along the umbonal slopes, and rather distinctly arcuated; hinge-line apparently nearly half the length of the valves, passing gradually into the slope of the posterior dorsal curve; posterior margin curving obliquely backward and downward to the rather narrowly-rounded posterior basal extremity; pallial margin broadly sinuous or arched, so as to be nearly parallel to the dorsal and posterior dorsal outline; anterior margin rounding up to the beaks, which are much depressed, extremely oblique, very slightly projecting, somewhat compressed, and placed nearly over the anterior end; umbonal slopes very prominently rounded, so as to form an oblique ridge, extending from near the beaks to the posterior basal extremity; above and behind this ridge, the surface is slightly convex, while the flanks below it are more or less concave. Surface ornamented with very fine and perfectly regular concentric lines.

Length, 1.95 inches; height, 0.77 inch; convexity, about 0.60 inch.

This shell agrees so very nearly in form and general appearance with *Modiola scalprum* of Sowerby, and especially with a form referred by Goldfuss and others to that species (see Petref. Germ., plate 130, fig. 9), that I am left in doubt whether it is not a mere variety of the same. It agrees less nearly with Sowerby's original figure, but his illustrations are not usually so accurate as those published by Goldfuss; while the figure referred to in the work of the latter author is, I believe, generally regarded as repre-

senting Sowerby's species. In one important character, however, our shell certainly differs, at least from the figures published by both of the above-mentioned authors; that is, in the great regularity of its concentric striae. If I knew their figures to be exactly correct in this respect, I should not hesitate to regard our shell as belonging to a distinct species; but, until this question can be settled by a comparison of specimens, I prefer to view it as a variety of Sowerby's species. In the fineness and regularity of its striae, as well as in its remarkable thinness, it agrees with *V. pertenuis*, M. & H., from the Jurassic beds near the Black Hills; but, in addition to being much larger, it is more arcuate, and has more prominent umbonal ridges; while its anterior ventral region below and in front of the umbonal ridge is proportionally larger. It is barely possible, however, that these may not be constant characters.

Locality and position.—Weber Cañon, Wasatch Range, Utah; Jurassic.

TRIGONIIDÆ.

Genus MYOPHORIA, Bronn.

MYOPHORIA LINEATA, Münster?

Plate 12, figs. 3, 3 a.

Trigonia lineata, Münster (1834), Leonhard und Bronn's Jahrb., I, 5 and 9.

Lyrodon lineatum, Goldf. (1838), Petref. Germ., II, 199, tab. 136, figs. 4, a, b, c, d.

Myophoria lineata, Münster (1841), Beiträge, IV, 88, tab. 7, fig. 29; and (1864) in Alberti's, Trias, 111.—Laube (1865), Fauna St. Cass., 59, tab. 18, fig. 7.

Trigonia lineata, Giebel (1852), Deutschl. Petref., 392.

Opis lineata, Laube (1864), Bemerk. im Jahrb. d. Geol. Reichsaust., 489; Fauna der Schicht. von St. Cass., 59, pl. xviii, fig. 7.

Shell small, trigonal, rather compressed; anterior end shorter than the other, rounding from below the beaks into the base; posterior side compressed, truncated, with a slight forward slope above, and angular at the base; ventral margin semioval, rounding up anteriorly, most convex in outline slightly in advance of the middle, and straight or very slightly sinuous near where it connects with the posterior basal angle; beaks apparently elevated, and placed a little in advance of the middle; posterior umbonal slope forming a well-defined angular ridge extending from the back part of

the beaks to the posterior basal angle. Surface ornamented with small, very regular, concentric costæ, which terminate abruptly on the posterior umbonal ridge of each valve, or are only continued on the compressed posterior dorsal region above the angle as fine lines of growth.

Length, 0.44 inch; height, about 0.36 inch; convexity, about 0.15 inch.

This shell seems to agree very closely in outline and surface-markings with the published figures of Münster's species, and I am inclined to believe it the same; though it is quite as probable that a good series of specimens would show specific differences separating it from that shell. As I have only seen a single imperfect specimen, however, and that presents no reliable characters by which it can be distinguished, I refer it with doubt to *M. lineata*. I should remark here that its costæ are much more strongly marked than on Münster's species, as illustrated by Dr. Laube, in his work on the St. Cassian Fossils, but in this respect our specimens agree exactly with Goldfuss' figures of that species.

Locality and position.—Weber Cañon, Wasatch Range, Utah; from above "quarry rock". In Europe, *M. lineata* occurs in the St. Cassian beds; but the shell here described appears to occupy a higher position (in the Jurassic series) if its exact position in the section was accurately determined.

ARCIDÆ.

Genus CUCULLÆA, Lamarck.

CUCULLÆA HAGUEI, Meek.

Plate 12, figs. 1, 1 a, 1 b.

Compare *Cucullæa concinna*, Phillips (1835), Geol. Yorks., 160, pl. v, fig. 9.

Shell small, oblong-subrhomboidal in outline, about once and a half as long as high, and rather gibbous in the central region; posteriorly a little obliquely truncated above, and obtusely-subangular and most prominent at its connection with the base below; base nearly straight and parallel to the cardinal margin along the middle, and rounding up rather more gradually in front than behind; anterior margin compressed, convex in outline, and connecting with the hinge above at an angle of about 98° ; hinge-line less than the greatest length of the valves; beaks rather prominent, gibbous,

incurved, and very nearly central; posterior umbonal slopes more or less angular, while the posterior dorsal region above these oblique umbonal ridges is compressed. Surface neatly ornamented with small, regular, radiating lines, or raised striæ, which are rather widely separated and larger on the anterior part of the valves, where they curve gracefully forward, and alternate with a smaller intermediate series, none of which are continued to the beaks; posteriorly they all become much smaller, and closely crowded; crossing all of these, there are, on all parts of the valves, numerous very small regular and crowded concentric lines.

Length, 0.57 inch; height, 0.35 inch; convexity, 0.30 inch.

This species seems to be closely allied to, and may even be identical with, some of the forms that have been referred to *Cucullæa concinna*, Phillips, by different authors. It certainly differs, however, very materially from the type of *C. concinna*, as originally illustrated by Phillips, in being much less depressed, proportionally shorter, decidedly less angular along the posterior umbonal slopes and at the posterior basal extremity. Phillips' figure also shows obscure, coarse, radiating costæ, on the posterior surface of the valves above the umbonal angle, not seen on our shell, which likewise differs in having more prominent and more gibbous umbones, with a more rounded basal outline. It is more nearly like the form figured under Phillips' name by Goldfuss (Petref. Germ., plate cxxiii, fig. 6 *a, b*), and by Quenstedt (Der Jura, tab. 67, fig. 16); but it is less angular at the extremities, and has more gibbous umbones. It may also be compared with a shell figured from the Jura by Richard Andree, in the Zeitschrift der Deutschen Geologischen Gesellschaft, XII, plate xiv, fig. 7, under d'Orbigny's name *Arca subconcinna*, which, however, is less depressed, much more rounded in outline, and has smaller and lower umbones than our shell.

Locality and position.—Weber Cañon, Wasatch Range, Utah; from a limestone apparently of Jurassic age.

ANATINIDÆ.

Genus MYACITES, Auct.

MYACITES (PLEUROMYA) SUBCOMPRESSA, Meek.

Plate 12, figs. 6, 6 a.

Myacites (Pleuromya) subcompressa, Meek (1873), Hayden's Ann. Rep. U. S. Geol. Survey of the Territories, 472.

Shell of medium size, oblong-subovate, moderately convex, the greatest convexity being nearest and above the middle of the anterior end; valves nearly closed, or but slightly gaping behind; posterior margin somewhat abruptly cuneate, rounded in outline, though slightly more prominent below the middle; basal margin with a moderately convex outline, rounding up more gradually behind than in front; anterior end short, subtruncated; dorsal margin rather short, rounding off gradually into the posterior margin; beaks gibbous, but somewhat flattened on the outer side, rather prominent, and located about half-way between the middle and the anterior end; anterior umbonal slopes prominently rounded, or forming a rounded undefined ridge, which descends nearly vertically from the anterior side of each beak to the anterior basal margin; the sides behind this ridge being a little flattened, or possibly sometimes slightly concave below. Surface marked by small, rather regular, but not strongly-defined, concentric ridges that become nearly obsolete on the posterior dorsal region and near the front.

Length, 1.27 inches; height, 0.92 inch; convexity, 0.66 inch.

This shell closely resembles some varieties of *Pleuromya ferruginea* and *P. impressa*, Agassiz, but has the anterior end shorter and more truncated, the concentric ridges of less regularity, and the concavity extending from the beaks to the anterior basal margins of the valves either entirely wanting or very feebly marked. In first preparing this report, I had written the above diagnosis of this species, and prepared the figure on plate 12; but being in doubt respecting its affinities, I did not then propose a name for it. Subsequently numerous specimens of this shell were brought in by Dr. Hayden's party from the Cañon of Yellowstone River; Spring Cañon; near Fort Hall, Montana; and other localities. These show that it varies considerably in

form and the distinctness of its costæ, though our figure on plate 12 gives a good idea of the most usual appearance of this shell.

Locality and position.—Weber Cañon, Wasatch Range, Utah; Jurassic.

MYACITES INCONSPICUUS, Meek.

Plate 12, fig. 10.

Shell very small, depressed, elongate-subelliptic, moderately convex; posterior margin narrowly rounded; anterior very short, truncated obliquely forward from the beaks above, and rounded below; basal margin, subparallel to the dorsal, most convex in outline at or slightly behind the middle, and a faintly sinuous anteriorly; dorsal outline nearly straight, and horizontal behind the beaks, but rounding off very gradually posteriorly; beaks somewhat tumid, rising slightly above the cardinal margin just behind them, and placed near the anterior end; posterior umbonal slopes prominently rounded; while a broad shallow compression, or slight concavity, extends from the beaks to the anterior ventral margin of each valve. Surface only showing obscure concentric marks of growth.

Length, about 0.45 inch; height, 0.20 inch.

Although there is nothing particularly notable in the form or general appearance of this little shell, I have been unable to identify it with any of the described species. Perhaps its most marked features are its small size, depressed form, and narrowly-rounded extremities. It may be a young shell, and in larger individuals, more nearly approaching some of the described species; but my present impression is that it is new.

Locality and position.—Weber Cañon, Wasatch Range, Utah. The specimen was supposed to have come from the rock in which the *Spiriferina* and *Aviculopecten* of the same plate were obtained; but it probably belonged to some Jurassic bed at that locality. (See note on the explanations of plate 12.)

MYACITES (PLEUROMYA) WEBERENSIS, Meek.

Plate 12, figs. 11, 11 a.

Shell of about medium size, moderately gibbous, subovate; anterior side very short and subtruncated, but rounding into the base; basal margin forming a semiovate curve, more prominent anteriorly, and curving up more

gradually behind; posterior side apparently narrowly rounded, and most prominent above the middle; beaks nearly over the anterior margin, rather pointed, depressed, and strongly incurved. Surface ornamented by numerous, rather small, but well defined and very regular, concentric costæ, about equaling in breadth the furrows by which they are separated.

Length, about 1.40 inches; height, 0.81 inch; convexity, 0.72 inch.

The only specimen of this species in the collection has had about one-third of the posterior dorsal region broken away. The general outline, however, can be pretty accurately inferred from the curve of the costæ. It has somewhat the appearance of the anterior portion of an *Allorisma*; and I am not quite sure that it may not more properly belong to that genus, especially as it seems to have the cardinal margins of the valves inflected, as we see in *Allorisma*. Still the curves of its costæ show that it was a proportionally shorter shell than is usual in that genus, and its beaks are more nearly terminal than is often seen in *Allorisma*.

Locality and position.—Weber Cañon, Wasatch Range, Utah. Originally supposed to have come from the same horizon as the *Spiriferina* and *Aviculopecten* figured on the lower half of the same plate; but as those shells are certainly of Carboniferous age, this one, unless it may be an *Allorisma*, probably belonged to a higher horizon, although found loose with the other forms mentioned.

CEPHALOPODA.

BELEMNITIDÆ.

Genus BELEMNITES, Auct.

BELEMNITES NEVADENSIS, Meek.

Plate 12, figs. 7, 7 a, 7 b (and 8 a, 8 b?).

Guard attaining a medium or larger size, gradually tapering, apparently not perfectly straight; section circular at the anterior end, but compressed-elliptic near the posterior end; alveolus elongate-conical, and extending back nearly half the length of the guard; surface smooth.

Length, about 3.25 inches; diameter at the anterior end, 0.60 inch; larger diameter, at 2.60 inches behind the anterior end, 0.46 inch; smaller diameter, at the same point, 0.30 inch.

From another locality in the same region in which the guard described above was obtained, several fragments were bought in, of an elongate-conical chambered shell, that may be the phragmacone of the same or of another Belemnite. It is represented by figs. 8 and 8 *a* of plate 12, and will be seen to taper regularly from the larger to the smaller end. Its section at all points is very nearly circular, while its septa are deeply concave, and separated by spaces equaling about one-fifth the greater diameter of the shell at the point of measurement. The siphuncle is very slender, and exactly marginal; surface smooth, or only showing under a magnifier, traces of obscure lines of growth that arch forward on the side opposite the siphuncle. The whole shell must have been, when entire, nearly six inches in length, and, if really the phragmacone of the above Belemnite, it must be evident that that species attained a much larger size than the guards figured would indicate.

Whether the last-mentioned shell is the phragmacone of a Belemnite, or the shell of an Orthoceras, may perhaps admit of some doubt until better specimens can be obtained; but that the guard described above is that of a true Belemnite, there can be no doubt whatever.

Locality and position.—The specimens of the guard are labeled "Cottonwood Cañon, West Humboldt Range", and came, I am informed by Mr. King, from the upper beds of the series, above those containing the Triassic fossils, and are therefore probably of Jurassic (Liassic) age. The larger chambered shell (figs. 8, 8 *a*) is labeled "American District, West Humboldt Range," Nevada; and probably came from the same horizon.

CRETACEOUS FOSSILS.

MOLLUSCA.

OSTREIDÆ.

Genus OSTREA, Linn.

OSTREA (undt. sp.).

Plate 15, figs. 10, and 10 *a*, *b*, *c*.

Shell of about medium size and thickness, more or less elongate-subovate, tapering to the beak, which is usually abruptly pointed, and often bent a little to the left or to the right, generally compressed and subequivalve. Lower valve rather shallow; ligament-area triangular, with its mesial furrow usually deep; surface merely showing appressed imbricating laminæ of growth, without any traces of radiating ridges, plications, or striæ. Upper valve a little more flattened, or sometimes nearly as convex as the other, but rather less concave within; beak usually more obtuse, and the ligament-area often proportionally a little shorter, with its mesial ridge well defined; lateral margins often thickened and crenated near the beaks; surface much as in the other valve.

Length of a medium-sized specimen, about 2.80 inches; breadth, 1.90 inches; convexity of the two valves, about 1 inch.

In first preparing this report, I merely gave figures of this Oyster without a specific name. Subsequently, in revising portions of the report, without having the type-specimens at hand for comparison, I was impressed with the similarity of this shell, as figured on our plate, to a species that I had in the mean time described in one of Dr. Hayden's reports from Wyoming, under the name *O. Wyomingensis*, and placed that name with a mark of doubt opposite its number on the explanations of the plate, while I also in the same way mentioned it in a list of Coalville species. Having since made a direct comparison of the specimens from the two localities, I am led to doubt their specific identity, though they are certainly very much alike. The Coalville specimens have the beak of the under valve less curved upward, and the lateral margins of the only upper valve I have seen from that

locality more strongly crenate or transversely striated than I have yet seen in any example of the Wyoming shell. As I have only two lower valves and one upper from Coalville, it is not possible to say to what extent this shell may vary. If distinct from *O. Wyomingensis*, it might be called *O. Coalvillensis*.

Locality and position.—Coalville, Utah; Cretaceous.

ANOMIIDÆ.

ANOMIA RÆTIFORMIS, Meek.

Shell of well-developed specimens transversely subovate, generally more



Anomia rætiformis.
Cast of upper valve, natural size.

broadly rounded on the left side (as seen from above), and rather narrowly rounded on the right margin, with the pallial margin between semiovate in outline; upper valve moderately convex, the greatest convexity being toward the left margin, while the narrowly-rounded right margin is more compressed and produced; beak marginal, nearly central, with generally a slight curvature toward the right; surface showing small, obscure wrinkles and striæ of growth, with sometimes traces of

a few indistinct radiating markings on the most convex part of the umbo; lower valve unknown.

Greatest (transverse) diameter, 1.26 inches; diameter from beak to pallial margin, 1.12 inches; convexity of upper valve, about 0.30 inch.

This species presents, in the well-developed adult, a singular *Ræta*-like form, being narrowed and subrostrate, or more or less produced on the right (posterior) margin. The younger specimens are generally more nearly circular in form.

I know of no other Cretaceous species of the genus very nearly allied to this.

Locality and position.—Ridge southeast of Laporte, Colorado Territory; Cretaceous. Horizon of the Fox Hills Group of the Upper Missouri section.

PTERIIDÆ.

Genus INOCERAMUS, Sowerby.

INOCERAMUS SIMPSONI, Meek.

Plate 13, fig. 3.

Inoceramus Simpsoni, Meek (1860), Proceed. Acad. Nat. Sci. Philad., XII, 312; and (1876) in Col. Simpson's Report Expl. across the Great Basin of Utah, 360, pl. iv, fig. 4.

Shell (right valve) attaining a rather large size, transversely oval-suboblong, gibbous, the greatest convexity being in the antero-central region, cuneate posteriorly; length nearly twice the height; anterior end very short and rounded from the beaks; base forming a long, semi-elliptic curve, most prominent near the middle, and somewhat straightened, or even slightly sinuous, posteriorly; hinge-line long, straight, and ranging parallel to the longer axis of the shell; posterior margin subtruncated, with a slight backward slope above, and forming an abrupt curve into the oblique posterior basal margin; beaks depressed so as to project little above the hinge-line, incurved, and placed nearly over the anterior margin. Surface ornamented with moderately distinct, regular, concentric undulations and lines of growth.

Length, 8.10 inches; height, about 4.30 inches; convexity of right valve, nearly 2 inches.

The only specimen I have seen of this shell is a cast of the interior of the right valve, with some portions of the moderately thick fibrous shell attached. It belongs to the group *Catillus*, as most generally understood, excepting in wanting the peculiar flexure near the cardinal margin; that is, to the group composed of nearly equivalve (or, at any rate, not very strongly inequivalve) shells, with a more or less elongated hinge, ranging nearly or quite parallel to the longer axis of the valves, instead of having a shorter hinge standing nearly at right angles to the longer axis, as in the typical forms of *Inoceramus*, which latter are often decidedly inequivalve. Although I have seen but the right valve of this shell, it is evident, from its moderately gibbous, as well as transversely elongated form, that it does not belong to the more inequivalve section of the genus. Its most remarkable characters are its transversely elongated, very inequilateral form; being proportion-

ally longer and more depressed than any otherwise nearly allied species with which I am acquainted.

Locality and position.—North Platte River, above Platte Bridge, in Dakota Territory; from the Cretaceous formation No. 2 or 3 of the Upper Missouri section. Discovered by Colonel Simpson. Museum of the Smithsonian Institution.

INOCERAMUS PROBLEMATICUS, Schlot.?

Plate 13, figs. 2 and 2 a.

Mytilites problematicus, Schloth. (1820), Petref., 312.

Inoceramus mytiloides, Sowerby (1823), Min. Conch., V, 61, pl. 442; Goldf. (1836), Petref., II, 118, tab. cxiii, fig. 4.

Catillus Schlotheimii, Neilsson (1827), Petref. Suecana, 19.

Catillus mytiloides, Deshayes (1830), Encyc. Méth., II, pl. 211.

Inoceramus problematicus, d'Orbigny (1843), Paléont. Fr., III, 510.—Meek (1873), Hayden's Sixth Report, 476; and (1876) in Col. Simpson's Report Expl. across Great Basin of Utah, 358, pl. 4, fig. 1 a.

Compare *I. mytiloides*, Roemer (1852), Kreid. von Texas, 60, pl. vii, fig. 5 (= *I. mytilopsis*, Conrad (1857), U. S. and Mex. Bound. Report, I, 152, pl. 5, figs. 6 a, and 6 b; also with *I. pseudo-mytiloides*, Schiel (1855), Pacific Railroad Reports, II, pl. 3, fig. 8.

Shell obliquely subovate, extremely inequilateral, rather compressed, and apparently nearly equivalve; anterior margin truncated or sloping very obliquely backward from the beaks to near the middle, where it passes imperceptibly into the base; basal margin sloping obliquely backward and rounding into the posterior basal extremity, which is generally narrowly rounded; hinge-line rather short and very oblique to the longer axis of the valves; posterior dorsal margin sloping obliquely with a more or less convex outline from the posterior extremity of the hinge to the posterior basal margin; beaks very oblique, acutely pointed, incurved, and terminal. Surface ornamented with small, more or less regular, concentric undulations and striae.

At the time I wrote the above description, I had seen only the figured specimens, which are much broken and distorted. Since that time, I have had an opportunity to collect and examine a large series at the same locality in Wyoming from which those figured on plate 13 were collected. These additional specimens show that this shell varies greatly in form; there being apparently an unbroken series from specimens like those figured on our

— showing
young
kind of

plate to forms much broader posteriorly, and less oblique. They all agree, however, in having the beaks much more attenuated and curved forward than in any figures of Schlotheim's *I. problematicus* I have seen. Some of the broader forms agree more nearly with some of those cited above, and figured by Roemer and others from western localities; but still they have more pointed and oblique beaks. I suspect that this shell belongs to a distinct species from *I. problematicus*; but, if so, it will probably have to be designated by Dr. Schiel's name *I. pseudo-mytiloides*.

Locality and position.—The figured specimens were brought by Colonel Simpson's party from a bed of yellow Cretaceous Sandstone over a bed of coal, at the mouth of Sulphur Creek on Bear River, Wyoming. (See bed number 12 of sec., on page 451, Dr. Hayden's Sixth Ann. Rep., 1873.)

INOCERAMUS (sp. undt.).

Plate 13, figs. 4, 4 a.

Compare *I. dimidiatus*, White (1876), Palæont. Wheeler's Surv., 179, pl. XVI, figs. 2 a-d.

This is a neat, symmetrical, little shell, of obliquely-ovate or mytiloid form, with rather pointed, oblique, terminal beaks, and very regular, distinct, concentric surface-undulations. It may be a young of the last, or an entirely distinct species. In some respects, it resembles one of the forms figured by Mr. Conrad in the United States and Mexican Boundary Report (I, plate 5, fig. 6 b); but it has much more regular surface-undulations, and apparently more produced beaks. I was long inclined to believe it the young of the last described form; but it may be distinct.

[Long since the above was written, Dr. White described from Lieutenant Wheeler's collections, a form under the name *I. dimidiatus*, from near Pueblo, Colorado, that agrees very nearly with this, and I am rather inclined to believe it to be the same. He had so many specimens all of the same small size, as to lead to the conclusion that it is most probably distinct from *I. problematicus*.]

Locality and position.—Cretaceous sandstone, on Sulphur Creek, near Bear River, Wyoming. (Benton or Niobrara group of Upp. Mo. Sec.)

INOCERAMUS ERECTUS, Meek.

Plate 13, figs. 1 and 1 *a*; and pl. 14, fig. 3.

Compare *Inoceramus Elliottii*, Gabb (1868), Palæont. of California, II, 193, pl. 31, fig. 90.

Shell attaining a medium size, vertically ovate-oblong, being higher than wide, not oblique, very gibbous, and nearly or quite equivalve; hinge shorter than the antero-posterior diameter of the valves, and ranging at right angles to their longer (vertical) axes; basal margin regularly rounded; anterior margin truncated nearly vertically from the front of the beaks more than half-way down, but rounding into the base below, inflected in both valves along the rather gibbous anterior umbonal slopes, so as to form a long, undefined, lunule-like excavation, that extends more than half-way down from the beaks; beaks not very prominent, abruptly pointed, very nearly equal, incurved with rather slight obliquity, and placed nearly directly over the vertical anterior margin. Surface of both valves ornamented by regular, medium-sized, concentric undulations, which are usually obsolete on the posterior dorsal region and the inflected anterior margins.

Height, about 2.50 inches; length, 2 inches; convexity, 2.30 inches.

As I have only seen imperfect specimens (mainly casts in sandstone) of this shell, and Mr. Gabb merely gives a single side-view of one specimen of the California species *I. Elliottii*, without measurements, I have doubts in regard to the relations of these shells. In outline, as seen in a side-view, it agrees well with Mr. Gabb's figure cited above, excepting that it appears to be more convex than his shading would indicate, and has more obtuse undulations.

[Since writing the above, I have, through the politeness of Mr. Gabb, had an opportunity to compare our shell with the type of his *I. Elliottii*, and I am led to regard the two as belonging to distinct species. The California form is, as I had inferred from Mr. Gabb's figures, much more compressed; while its surface undulations differ decidedly in being very acutely angular. As I have not been able to identify our shell with any other described species, I add the name *I. erectus* for it here as this report is passing through the press.]

Locality and position.—Chalk Creek, near Uptown, Utah; Cretaceous.

INOCERAMUS DEFORMIS, Meek.

Plate 14, figs. 4, 4 a.

Inoceramus ———?, Hall (1845), in Gen. Frémont's Report Expl. Rocky Mts., 309, pl. iv, fig. 2.

Inoceramus deformis (1872), Hayden's Second Ann. Report U. S. Geol. Survey of the Territories, 296.—White (1876), Palæont. Wheeler's Survey, 179, pl. xv, figs. 1 a, b.

Compare *Haploscapa capax*, Conrad (1874), in Hayden's Ann. Geol. Report for 1873, 456; also *H. grandis*, Conrad (1875), in Cope's Report on the Vertebrates of Hayden's Survey, 23, pl. lvi.

Shell attaining a rather large size, obliquely ovate, and rather compressed in young examples, but more rounded, gibbous, and irregular, as well as much less oblique, in adult specimens; more or less inequivalve, but never very decidedly so; posterior and basal margins rounded; the latter curving up more gradually and obliquely to the short anterior margin; hinge short and usually not very oblique; beaks moderately prominent and placed between the middle and the anterior margin; neither greatly more elevated than the other. Surface ornamented with large, strong, concentric undulations, which are sometimes moderately regular, but often very irregular, and generally becoming rather abruptly smaller on the umbones, where their curves indicate the greater obliquity of the young shell.

Height of a medium-sized specimen, about 4.50 inches; length of same, 4.30 inches; convexity of right valve, about 2.50 inches.

I have frequently had under examination, during the last twelve years, specimens of this shell, without being able to identify them with any described species. Nearly all of the explorers who have visited the eastern slope of the Rocky Mountains between the south branch of Platte River and New Mexico have brought in specimens of it, but almost always in a distorted or broken condition. Its distortion, however, is evidently not always due to accident, since it often resulted from one of the depressions between two of the undulations being so much larger and deeper than the others, as to give the valves a remarkably constricted appearance. In other cases, it resulted, in part at least, from the great irregularity in the size of the undulations themselves. Although it is often found distorted in general form by accidental pressure, it was evidently also naturally quite variable in outline, particularly in convexity.

Our figured specimen is merely an imperfect internal cast of a right valve with the umbonal and anterior portions broken away.

Professor Hall seems, from his remarks in Frémont's report, to have regarded this shell as being related to *I. involutus* of Sowerby. It is, however, very distinct from that species, and even belongs to a different section of the genus, as it certainly did not have one valve very greatly larger than the other, as I know from the examination of numerous specimens of both valves. The specimen figured by Professor Hall, and described by him as being "flat", is, as may be readily seen by the curve of the undulations, a left valve; while the corresponding valve in *A. involutus* is extremely gibbous, elevated, and involute, being almost like a spiral univalve. His figure well illustrates a peculiar flattening of the umbonal region, and the greater obliquity of the undulations often seen on that part of both valves.

I believe the shell here described to be also the same as that on which Mr. Conrad has proposed to found a new genus, *Haploscapha*. Since the publication of his descriptions, already quoted, he has informed me that he had arrived at the conclusion that his proposed new genus is identical with *Catillus*, Brongniart; but that he still retains his name, on the ground that the name *Catillus* had been previously used for *Navicella*, Lamarck, by Humphrey, in 1797.* I have not had an opportunity to examine Mr. Conrad's specimens, but I had always supposed this shell to be an *Inoceramus*, and, like nearly all others, had believed *Catillus*, Brongniart, not to be more than subgenerically distinct from *Inoceramus* proper. If Mr. Conrad's name *Haploscapha* should be retained, the name of the species here described would probably become *Inoceramus (Haploscapha) deformis*. If not, it will probably be *Inoceramus (Catillus) deformis*.†

**Catillus*, of Humphrey, however, was published merely in a list, without any diagnosis, figure, or the citation of any known type, and therefore, I should think, ought not to stand.

† The principal characters that have led Mr. Conrad to separate such shells from *Inoceramus* are, if I have correctly understood him, a kind of rolling or flexure of the hinge-margin (none of our specimens are in a condition to show whether they possess this character of the hinge-margin or not), the entire absence of hinge-teeth, the very thin substance of the shell near the umbones, and its greater thickness at the free margins. There are various types of *Inoceramus*, however, without hinge-teeth; the

Locality and position.—Common in Kansas, and near Pueblo and Colorado City, as well as at other places in Colorado along eastern base of Rocky Mountains, and farther west; everywhere in the Benton and Niobrara Groups.

ARCIDÆ.

Genus CUCULLÆA, Lamarek.

CUCULLÆA (TRIGONARCA?) OBLIQUA, Meek.

Plate 14, figs. 1, 1 a, 1 b.

Shell attaining about a medium size, rhombic-subovate, moderately convex, the greatest convexity being along the posterior umbonal slope,

presence of one or more obscure anterior teeth being an exceptional, and not by any means a general, character in this group. *I. striatus*, Mantell, for instance, has one obscure anterior hinge-tooth in one valve, while the nearly allied *I. substriatus* is figured by Goldfuss without any traces whatever of such tooth. Again, Goldfuss figures another shell that he refers to *I. Brongniarti*, with indications of three small anterior hinge-teeth. On the other hand, *I. Cuvierii*, Sowerby, from which the original figures and description of the genus were prepared, has no hinge-teeth;* and, according to the best authorities, this is the case with nearly all the other known species the hinges of which have been seen.

In regard to the greater thinness of the shell at the umbones than at the free margins, it should be remembered that it is the outer prismatic layer, and not the inner pearly layer, that Mr. Conrad refers to. So far as I have been able to see, however, this outer layer is not unfrequently thinnest near the umbones, excepting under the beaks along the hinge, in different types of the genus. In our shell, this outer fibrous layer, like that of other species in the lower divisions of the Upper Missouri Cretaceous, is nearly always found with the inner pearly layer dissolved away, in which condition the fibrous part appears to have been flexible, as I have often seen it abruptly folded upon itself in various ways. The rolling-over of the hinge-margin in Mr. Conrad's type I should think not of generic importance. Mr. Conrad thinks *I. involutus* of Sowerby has the hinge-characters of his *Haploscapa*; but Dr. Stoliczka had previously proposed for that type the name *Volvicramus* as a subgenus under *Inoceramus*, in which genus all authorities have placed it.

Since writing the above, Mr. Conrad has informed me that he adopts the name *Volvicramus*, and ranges *Haploscapa* as a subgenus under it.

* Sowerby's original diagnosis of this genus, read before the Linn. Soc. in 1814, and published in the Trans. of same, XIII (dated 1821, but usually cited 1822-3), was drawn up from *I. Cuvierii*; and Parkinson, who first adopted the genus in Trans. Geol. Soc., 1821 (often cited 1819), mentioned first (p. 53) *I. Cuvierii*; while Mantell, who adopted it with a generic diagnosis in Geol. Suss., 1822 described under it first a species referred by him to *I. Cuvierii*. Hence this species has been cited as the type of the genus; but, owing to the fact that Sowerby, in publishing the genus in his Min. Con., III (title p. 1821, index 1822), described under it first *I. concentricus*, Park., some regard that as the type.

while the anterior ventral region is abruptly cuneate; anterior margin rounded in outline; base with a shallow semiovate outline, being usually slightly more prominent in advance of the middle; posterior margin long, and very obliquely truncated, with a slightly convex outline, from the hinge to the posterior basal extremity, which is prominent and subangular; hinge-margin very short, or little more than equaling one-third the length of the valves; posterior umbonal slopes prominent, and more or less angular from the beaks to the posterior basal angle; cardinal area short and rather narrow; beaks moderately prominent, incurved, and placed one-fourth to one-third the length of the valves from the anterior margin. Surface ornamented by moderately distinct lines of growth, crossed by obscure radiating costæ that are wider than the mere linear furrows between.

Length, 1.50 inches; height, 1 inch; convexity, about 0.70 inch.

I only know this shell from casts that do not show the hinge. They bear impressions, however, in some instances, of a ridge or projection along the margin of the posterior muscular scar, as in *Cucullæa*. From the general form of the shell, and its very short hinge-margin, I can scarcely doubt that it belongs to Mr. Conrad's group *Trigonarca*; but, until the hinge can be seen, its relations to that genus cannot be satisfactorily determined. I know of no very nearly allied species.

Locality and position.—East Cañon Creek, Wasatch Range, Utah; in a whitish sandstone of Cretaceous age.

Genus AXINÆA, Poli.

AXINÆA WYOMINGENSIS, Meek

Shell attaining a medium size, subcircular or very slightly longer than high, gibbous, thick, and strong; beaks rather prominent; basal margin semicircular, and rounding regularly upward in front into the anterior border, which rounds to the cardinal edge, so as scarcely to produce more than a very slight angularity at the connection of the two above; posterior margin making a slightly broader and similar curve, excepting that it is faintly sinuous above the middle; hinge-plate thick, moderately arched, with denticles rather strong, nearly straight, or a little curved, numbering about eight or ten well-developed ones in front, and seven or eight behind, with per-

haps a few other smaller ones toward the central region; cardinal margin short; hinge-area small, with apparently only a few coarse cartilage-fur-

Fig. 2.



Fig. 3.

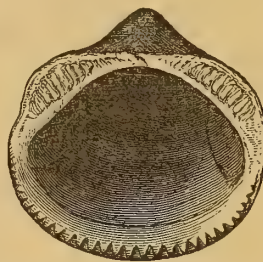
*Axinæa Wyomingensis.*

Fig. 2. Exterior or left valve, with surface somewhat eroded.

Fig. 3. Interior, and hinge of same.

rows; pallial margin strongly crenate within; surface ornamented by fine concentric striæ, and a few stronger marks of growth, crossed by about thirty-five to forty very obscure radiating, flattened, or much depressed costæ, only separated by scarcely perceptible narrow or linear furrows.

Height, 1.30 inches; breadth, 1.33 inches; convexity, 1.04 inches.

This species is perhaps as nearly allied to *A. subimbricata*, M. & H., as to any other Cretaceous form. It is a much thicker and more gibbous shell, however, with proportionally less transverse valves, and much less distinctly defined costæ. It also differs in having a broader hinge-plate and straighter hinge-denticles. If Poli's name *Axinæa* should not be retained for this genus, the name of this species here described will become *Pectunculus Wyomingensis*.

Locality and position.—East side of Cooper Creek, near Old Stage Station; Laramie Plains, Wyoming Territory; Cretaceous.

CORBULIDÆ.

Genus CORBULA, Bruguière.

CORBULA (undt. sp.).

Plate 14, fig. 2.

Shell transversely ovate-pyriform, being gibbous in the anterior and umbonal regions, and distinctly contracted, compressed, and subrostrate behind; ventral margin semiovate, with the most prominent part a little in advance of the middle; anterior margin truncated obliquely forward from the beaks above, and somewhat abruptly rounded from near the middle into the base; beak (of left valve) prominent, rather gibbous, incurved, and

placed in advance of the middle; dorsal outline somewhat concave behind the beaks. Surface apparently smooth. Hinge and interior unknown.

Length, 0.95 inch; height (of left valve), 0.66 inch.

I have seen but a single cast of the left valve of this shell (apparently of its exterior), and consequently know nothing of its hinge, muscular, and pallial impressions, nor of the relative convexity of its right valve. It will be seen, however, to agree very closely in form, so far as we have the means of making a comparison, with the large species *C. pyriformis*, from the fresh- or brackish-water deposits at the Sulphur Creek locality near Bear River, Wyoming, figured on plate 17. The resemblance is so close to certain forms of that variable species, such as fig. 2 *a* of plate 17, that I should have suspected that the label, indicating a different locality and position, had been accidentally associated with it, were it not for the fact that it is composed of a different material (a light-colored sandstone) from the matrix of the Sulphur Creek fossils. If the label really refers to its proper locality, it will probably prove to be a distinct species from that found at Sulphur Creek, as there seems, so far as yet known, to be no species common to the two localities, unless this one may be so. If a new species, *C. pirum* would be a good name for it.

Locality and position.—Coalville, Utah; Cretaceous sandstone.

CARDIIDÆ.

Genus CARDIUM, Linnæus.

CARDIUM CURTUM, M. & H.?

Plate 15, fig. 3 (not 3 *a*).

Cardium (*Hemicardium*?) *curtum*, Meek and Hayden (1861), Proceed. Acad. Nat. Sci. Philad., XIII, 442.

Shell truncate-suborbicular, with height and length generally about equal, and the greatest convexity along or near the angular posterior umbonal slopes; anterior margin rounding into the rounded or semi-ovate base, which is often most prominent slightly behind the middle; posterior margin obliquely truncated above, and very abruptly rounded or subangular below; beaks elevated, rather pointed, and strongly incurved at right angles to the hinge, placed slightly in advance of the middle; hinge-margin short; posterior

umbonal slopes and back part of beaks angular, the angularity being continued obliquely to the posterior basal margin, while the surface behind these angular slopes is flattened, and rather abruptly inflected to the truncated hinder margin. Surface ornamented by distinct radiating non-spiniferous costæ, about equal to the intermediate furrows; costæ largest and sometimes bifurcating on the flattened surface behind the umbonal angles, and simple and very regular in front of the same, where they gradually diminish in size anteriorly; lines of growth moderately distinct.

Length, about 0.80 inch; height, 0.75 inch; convexity, about 0.60 inch.

The specimens of this shell in the collection seem to agree pretty closely with *C. curtum*, but are proportionally slightly longer, with rather more depressed beaks, and less sloping anterior and posterior dorsal margins. Hence, I am not *quite* sure of their exact specific identity. At the time this report was originally prepared, I supposed the smaller shell, represented by fig. 3 *a* of the same plate, might possibly be the young of that here under consideration; but, on subsequently collecting and examining a number of specimens at the same district and horizon, I was led to believe these forms much more probably distinct, and consequently proposed the name *C. subcurtum* for that represented by our fig. 3 *a*, in one of Dr. Hayden's reports.

These shells belong to the genus *Cardium*, but not to the typical section. I originally referred the typical *C. curtum* very doubtfully to the section *Hemicardium*; but it cannot be properly included in that section, being much nearer the subgenus *Fragrum*, but still not agreeing with that group either.

Locality and position.—The type-specimens of *C. curtum* were brought by Captain Reynolds from Gros Ventres River, Wyoming, from a gray sandstone of Cretaceous age. The specimens here under consideration came from Chalk Creek, two miles west of Uptown, Utah, where they occur in a whitish Cretaceous sandstone.

CARDIUM SUBCURTUM, Meek.

Plate 15, fig. 3 *a* (not fig. 3).

Cardium subcurtum, Meek (1873), see foot note in Dr. Hayden's Sixth Ann. Report Geol. Survey of the Territories, 476.

Shell under medium size, truncato-suborbicular, about as high as wide.

rather convex, and but very slightly oblique; beaks nearly central, rather prominent, distinctly incurved almost at right angles to the hinge; posterior margin truncated with a slight forward obliquity, so as to connect with the dorsal margin at an obtuse angle; anterior margin rounding regularly into the base, which describes a slightly oblique semi-ovate curve, being more prominent behind, where it rounds up very abruptly to the posterior margin, so as to give a subangular outline to the posterior basal extremity; umbonal slopes rather prominent, but not angular; hinge-margin shorter than the length of the valves. Surface ornamented by small, regular, simple radiating costæ, and moderately distinct lines of growth.

I have seen specimens nearly twice the linear dimensions of that figured on plate 15; and, as these have the posterior umbonal slopes rounded instead of angular, there seems to be very little reason for doubting that it is a distinct species from the last. As already stated, I at first thought it the young of *C. curtum*; but the specimens I have since had an opportunity to examine have led to a different conclusion.

Locality and position.—Chalk Hill, near Coalville, Utah, where it occurs in a whitish sandstone of the coal-bearing Cretaceous series of that region. I also collected specimens of it between Coalville and Weber Cañon, at apparently higher horizons than the Chalk Hill beds.

MACTRIDÆ.

Genus MACTRA, Linnæus.

MACTRA? EMMONSI, Meek.

Plate 15, fig. 8.

Shell small, oval-subtrigonal, rather compressed, longer than high, nearly or quite equilateral, or with anterior side slightly longer than the other; basal margin forming a semi-elliptic curve; anterior margin narrowly rounded below the middle; posterior margin somewhat broader; most prominent and abruptly rounded or obtusely subangular below, and very faintly subtruncated obliquely above; dorsal margin sloping before and behind the beaks, the anterior slope being greater, with a concave outline; beaks nearly central, or sometimes placed a little behind the middle, rather depressed, and incurved with very slight obliquity; posterior umbonal slope very obscurely

angular from the beaks to the posterior basal extremity. Surface only marked by fine obscure lines of growth. (Hinge and other internal characters unknown.)

Length, 0.45 inch; height, 0.30 inch; convexity, 0.17 inch. Some specimens of apparently the same species are nearly double the size of that from which the above measurements were taken, and some of the smaller ones are proportionally a little shorter.

As I am unacquainted with the hinge and other internal characters of this little shell, it is only provisionally referred to the genus *Mastra*. In addition to this, until conchologists can agree in regard to which one of the several generic types included by Linnæus in that genus is to be regarded as the typical form, it is impossible to know what we ought to call a shell of this type, even where the specimens are in a condition to show clearly all the generic characters.

It is a smaller and more depressed shell than any of the known Upper Missouri Cretaceous *Mastras*, and more closely resembles a species described by Dr. Hayden and myself, from the southwestern base of the Black Hills, under the name *Tancredia Warrenana*, from beds believed, from their stratigraphical position, to belong to the Jurassic series. The typical specimens of the *T. Warrenana* are merely casts, showing none of the internal characters, but have almost exactly the form and general appearance of the genus *Tancredia*; though they may belong to some other genus. On critical comparison with the species under consideration, the latter is found to differ in having its beaks slightly more obtuse, its posterior umbonal slopes less angular, and its posterior margin more rounded in outline.

The specific name is given in honor of S. F. Emmons, Esq., of the United States Geological Survey of the Fortieth Parallel.

Locality and position.—East Cañon Creek, Wasatch Range, Utah, in an ash-colored sandstone, believed to belong to the upper bed of the Cretaceous of that region.

MASTRA (TRIGONELLA)? ARENARIA, Meek.

Plate 14, fig. 5.

Shell attaining a medium size, trigonal-subovate, rather compressed; posterior margin rounded, or sometimes faintly subtruncated; anterior more

narrowly rounded, most prominent a little below the middle; base forming a nearly semi-elliptic curve, being most prominent along the central region, and rounding rather more abruptly into the posterior margin; dorsal margin sloping from the beaks toward the extremities; beaks moderately prominent, but very slightly oblique, and very nearly central, or placed slightly behind the middle; posterior umbonal slopes with each a shallow but distinct sulcus extending obliquely from the beak toward the posterior basal margin. Surface ornamented by very regular, distinctly-defined, concentric lines and furrows. (Hinge and interior unknown.)

Length, 1.48 inches; height, 1.10 inches; convexity, about 0.60 inch.

As the specimens of this shell yet obtained show neither its hinge nor internal characters, it is not possible to determine from them whether it is a true *Mactra* (*Trigonella*), or a *Spisula*, or whether it belongs to some of the other allied groups. It has the form and general external appearance of *Mactra* (*Trigonella*), but differs from all of the otherwise similar described species of that genus known to me, in the distinctness and regularity of its concentric lines and furrows, as well as in the possession of the oblique posterior umbonal sulcus. In the latter character, it seems to agree very nearly with *Mactra? tenuistria*, Gabb (California Palæontology, vol. II, plate 29, fig. 68). It differs, however, in being proportionally longer and more abruptly or narrowly rounded in front, much more coarsely striated, and in having the posterior umbonal sulcus of each valve directed so as to reach the posterior margin farther up. This sulcus seems not to impart any distinct sinuosity to the posterior margin, but perhaps gives it a very slightly truncated appearance in some specimens.

Compared with the last, this species will be seen to differ, not only in its larger, more gibbous, and less depressed form, but in the possession of proportionally stronger concentric ridges and furrows.

Locality and position.—Whitish Cretaceous sandstone, including coal, on Red Creek, Uinta Mountains; and in the same rock on Chalk Creek, Utah.

MACTRA (CYMBOPHORA)? UTAHENSIS, Meek.

Plate 15, figs. 9, 9 a, and 9 b.

Shell subovate, moderately convex; anterior margin rounded; posterior

margin narrower, and rather abruptly rounded, or sometimes apparently slightly truncated, being most prominent below; basal margin forming a semi-elliptic or semi-ovate curve, being sometimes more prominent anteriorly; dorsal outline sloping from the beaks toward the extremities; beaks moderately prominent, very nearly central, and incurved with little obliquity; umbonal slopes merely rounded, and not terminating in a flexure of the posterior basal margin. Surface apparently merely marked with fine, obscure, irregular lines of growth. Hinge merely known to possess linear anterior and posterior lateral teeth. Ligament and internal characters unknown.

Length, 1.35 inches; height, 0.90 inch; convexity, about 0.50 inch.

The specimens of this shell in the collection agree so nearly with a form described by the writer in connection with Dr. Hayden, from the Upper Cretaceous beds on Deer Creek near the North Platte, under the name *Tellina nitidula*, that I was at one time inclined to think they might belong to a variety of that species. Still, as they are merely internal casts, giving but a limited knowledge of the hinge, and showing nothing of the internal characters, it is much more probable that they are really very distinct. So far as regards their form and general appearance, they seem only to differ in having the anterior side rather more produced and sometimes wider.

From this general resemblance, however, I have, in the absence of any knowledge of the nature of its cardinal teeth or pallial line, ventured to refer it provisionally to the same section of the *Macra* group to which *Tellina nitidula* is now believed to belong; that is, to *Cymbophora*, Gabb. I should have been inclined to refer it to *Macoma* or *Gastrana*, were it not for the impressions of lateral teeth seen before and behind the beaks in the casts.

Locality and position.—Whitish Cretaceous sandstone, East Cañon Creek, Wasatch Range, and near Coalville, Utah.

TELLINIDÆ.

Genus TELLINA, Linnæus.

TELLINA??ISONEMA, Meek.

Plate 15, fig. 6.

Shell transverse, elliptic-subtrigonal in outline, compressed, and nearly

or quite equilateral; anterior margin narrowly rounded; base forming a semi-elliptic curve; posterior end narrowly rounded or subangular at the termination of a slight, oblique flexure of the valves; dorsal margin sloping from the beaks to the extremities, with a moderately convex outline; beaks almost central, rather small, and projecting little above the cardinal margin. incurved with scarcely any visible obliquity; hinge and interior unknown. Surface ornamented by fine, perfectly regular, concentric, thread-like lines, gradually becoming smaller and more crowded toward the umbones, on which they are nearly or quite obsolete.

Length, 0.90 inch; height, 0.60 inch; convexity, about 0.20 inch.

The fact that this is one of the characteristic shells of the formation in which it occurs seems to render it desirable that some notice should be taken of it, although we have not the means of arriving at satisfactory conclusions in regard to its affinities. At the same time that I place it provisionally in the above genus, I really have very little faith in its belonging properly to that group. It seems to be a very thin shell, as the specimens (which in some instances appear to be internal casts) show the exceedingly regular thread-like concentric lines quite distinctly. In some of these casts there are appearances of the impression of a thin lamina, or very slender ridge, nearly parallel to the hinge-margin both behind and in front of the beaks. These may have been left by elongated lateral teeth; though they appear not to be exactly marginal, but a little removed from it, as if they had been made by a thin projecting lamina, somewhat similar to the cartilage-support in the genus *Edmondia*. I do not think the shell at all related to that group, however.

After numerous comparisons, I have been unable to identify this shell with any described species.

Locality and position.—In whitish and buff-colored sandstone, at Chalk Creek, above Coalville, Utah; also in a similar matrix from East Cañon Creek, Wasatch Range; Cretaceous.

TELLINA MODESTA, Meek.

Plate 15, figs. 4 and 5.

Shell rather small, transversely elongate-subelliptic, being twice as long as high, rather distinctly compressed; anterior margin narrowly rounded;

base forming a long, semi-elliptic curve; posterior extremity more narrowly and less regularly rounded than the other, apparently slightly bent to the left; dorsal margin declining very slightly, with convex slopes, both in front and behind the beaks; beaks very nearly central and inconspicuous, being depressed and compressed. Surface of casts smooth, but probably on well-preserved shells marked with fine concentric striæ. Hinge and interior unknown, with the exception of some appearances of lateral teeth seen in casts.

Length, 0.86 inch; height, 0.44 inch; convexity, 0.10 inch.

This little shell has the general form of *Tellina*, or *Abra*, but without seeing the hinge and interior it is impossible to determine whether it may not belong to some allied, but distinct, group. It is a more depressed shell than *T. scitula*, M. & H., or any of the other species from the Cretaceous rocks of the Upper Missouri, and I have been unable to identify it with any of the known American or foreign species. Perhaps the most nearly allied American fossil species yet known is Mr. Gabb's *T. Ashburnerii* (from division A of the California Cretaceous series), which, however, is a proportionally higher (wider) shell, with much less depressed and more angular beaks.

Locality and position.—Whitish sandstone of East Cañon Creek, Wasatch Range, upper part of series; Cretaceous.

VENERIDÆ.

Genus CYPRIMERIA, Conrad.

CYPRIMERIA ? SUBALATA, Meek.

Plate 15, fig. 7.

Cyprimeria subalata, Meek (1873), Hayden's Sixth Report U. S. Geol. Survey of the Territories, 476.

Shell transversely broad-subovate or subelliptic, strongly compressed; extremities rather narrowly, and nearly equally rounded; basal margin forming a regular semi-elliptic curve, being most prominent along the middle, and rounding up gradually and equally into the anterior and posterior lateral margins; dorsal margin sloping from the beaks, the posterior slope being more convex in outline than the anterior; beaks small, scarcely pro-

jecting above the hinge-margin, very nearly or exactly central, and almost entirely without obliquity. Surface apparently smooth, or only showing very fine, obscure, concentric striæ. (Hinge and interior unknown.)

Length, 1.22 inches; height, 0.90 inch; convexity of left valve, only about 0.12 inch.

Although I have seen only casts of this species, giving no satisfactory knowledge of its hinge and internal characters, from its very close similarity to *Cyprimeria depressa* of Conrad, described from the North Carolina and Mississippi Cretaceous rocks, I can scarcely doubt its generic identity with that shell. It is quite unlike Mr. Conrad's type-species of *Cyprimeria* (*C. excavata*), so much so, indeed, that I should not have suspected it to belong to the same genus. Its *very* close specific relations, however, as stated above, to *C. depressa*, which has the characteristic hinge of *Cyprimeria*, leaves little reason for doubts on this point. On comparison with good specimens of *C. depressa*, sent to me by Mr. Conrad, I find our shell only differs (in external characters at least) in having its beaks a little less flattened and placed slightly farther forward, while its posterior dorsal outline is somewhat less straightened, and its anterior outline a little less narrowly rounded. These, however, are not greater differences than we often see between different individuals of the same species among such shells.

Locality and position.—Whitish Cretaceous sandstone, at East Cañon, Wasatch Range; Utah.

GASTEROPODA.

NATICIDÆ.

Genus GYRODES, Conrad.

GYRODES DEPRESSA, Meek.

Plate 15, figs. 1, 1 a.

Shell depressed so as to be about twice as wide as high; volutions three to three and a half, increasing rapidly in size; last one widest below the middle, narrowly rounded, but not angular on the under side, at least in casts; spire much depressed; suture channeled in such a manner as to be flattened within, owing to the presence of a revolving furrow just above it; umbilicus wide and depressed-conical in form, without showing any revolv-

ing ridges within; aperture obliquely suboval, with its longer axis ranging downward and outward. (Surface unknown.)

Height, 0.55 inch; breadth, 1.05 inches.

The specimens of this shell in the collection are merely casts in a very fine arenaceous material. It certainly differs, however, in its much depressed form, from any otherwise similar described species with which I am acquainted. Its umbilicus is quite wide, but diminishes rapidly in breadth within, in consequence of the depressed form of the shell. The under side of the body-volution is prominently and narrowly rounded around the umbilicus, but not properly angular; at any rate not so in casts. Owing to the form of the body-volution, the aperture has an oblique outward slope. The whorls seem not to be truncated around the upper edge, as is often the case in this genus; but a revolving furrow, just above the suture, gives the latter a duplicated or banded appearance, the band forming a flattened bottom to the channeled suture. Only faint traces of very oblique lines of growth are seen on the cast.

Locality and position.—Chalk Creek, at the mouth of the cañon, above Coalville, in the whitish Cretaceous sandstone series, Utah.

APORRHAIIDÆ.

Genus ANCHURA, Conrad.

ANCHURA? FUSIFORMIS, Meek.

Plate 15, figs. 2, 2 a.

Shell subfusiform; spire conical, rather short; volutions about five, moderately convex, those of the spire smooth and separated by a comparatively distinct suture; last one subovate, obscurely angular around the middle in young examples, but with angle entirely obsolete in the adult, gradually tapering below into a long, straight, rather stout canal, which has some appearance of being obliquely truncated at the extremity; outer lip, with extension apparently short, simple, and slightly recurved; surface with only obscure lines of growth, excepting near the lip on the body-volution in adult shells, where there are usually a few small, slightly oblique, longitudinal costæ, that become obsolete before reaching the suture above and a little below the middle of the volution. (Aperture and columella unknown.)

Length of the largest specimen seen, including canal, about 1.28 inches; breadth of body-volution, including the lip as far as preserved, about 0.70 inch.

The specimens of this shell are unfortunately not in a condition to show the entire lip, though they leave no room for doubting that it is more or less extended. The fact that the commencement of a single mesial angle can also be seen on the outside of the dilated part indicates that the lip probably has but one spur; and, from a slight upward curve of this angle, it is probable the extended part is more or less recurved. None of the specimens show the inner lip or the exact form of the aperture.

Owing to the stoutness and straightness of the canal, and the presence of flexuous costæ on the outer side of the body-volution in this species, it presents some general resemblance to *Pugnellus manubriatus*, Gabb, from the Cretaceous rocks of California. Unfortunately, no specimens have been found in a condition to show whether or not it has the outer margin of its lip thickened as in that genus; but it seems not to present that character. It at least differs specifically from *G. manubriatus* in having its canal more slender and elongated, and its spire more elevated.*

Locality and position.—The type-specimens were found at the water-tank two miles from Coalville, Utah, and on Chalk Creek above Coalville, in a whitish Cretaceous sandstone. I also found several specimens of it at Coalville, in bed No. 11, of section given on page 439 of Dr. Hayden's Sixth Annual Report of the United States Geological Survey of the Territories, 1873.

* Since the foregoing description and remarks were written (in 1870) Dr. White has figured and described, in his report on Lieutenant Wheeler's collections (page 190, pl. xvii, fig. 4), a shell from New Mexico supposed to belong to this species. Although when he showed me his specimens with others when I was lying sick at Oakland, Md., in 1874, I was inclined to believe it not distinct from this species, a later comparison has led me to regard the New Mexican shell as belonging to another species with a more elevated and more slender spire. Better specimens of the two forms would doubtless show other differences.

SIPHONARIIDÆ.

? Genus ANISOMYON, M. & H.

ANISOMYON SEXSULCATUS, M. & H.?

Helcion sexsulcatus, Meek and Hayden (1856), Proceed. Acad. Nat. Sci. Philad., VIII, 68.*Anisomyon sexsulcatus*, Meek and Hayden (1860), Am. Jour. Sci., XXXVIII (2d ser.),35.—Meek (1876), Palæont. Upper Missouri, 293, pl. 18, figs. 8 *a*, *b*.

Fig. 4.

*Anisomyon sexsulcatus*.

Fig. 4. An internal cast as seen from above—(nat. size).

Fig. 5.

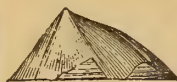


Fig. 5. A side-view of same.

The specimen I have here referred doubtfully to the above species is smaller than the original type of the same, being but little more than half the linear dimensions of that species. It also has its apex proportionally a little higher, and the anterior slope slightly convex near the apex, instead of concave; while it shows on the internal cast an obscure mesial carina down the posterior slope, not seen on the cast of the type of *A. sexsulcatus*. It shows the six radiating furrows, however, exactly as in that species, and agrees so very nearly in all other known characters that I have concluded to refer it provisionally to the same.

The original type-specimen of *A. sexsulcatus* is an imperfect cast of the interior, retaining only thin films of the inner layer of the shell. That now before me is also an internal cast, but retains some fragments of the shell near the margin, and one of these shows that there is, as I had long since conjectured, a narrow furrow on the outer surface of the shell over each of those seen on the internal cast. These fragments of the shell, although apparently not worn, show only obscure marks of growth.

I suspect that a good series of specimens may show this shell to be a distinct species from *A. sexsulcatus*, of smaller size. If so, it may be called *A. Wyomingensis*.

Locality and position.—Outer sandstone ridge southeast of La Porte, Colorado; Fox Hills Group of the Upper Missouri Cretaceous series.

FOSSILS OF THE BEAR RIVER FRESH- OR BRACKISH-WATER BEDS.

As it is still a matter of some doubt whether the above-mentioned highly-inclined strata seen on Sulphur Creek near Bear River, Wyoming, very nearly conformable to well-marked marine Cretaceous beds at the same locality, belong to the latest member of the Cretaceous or to the earliest Eocene Tertiary, I prefer to describe the fossils from them here separately under a distinct heading. I have from the first inclined to the opinion that these brackish-water beds belong to the horizon of the oldest Eocene, though I have several times mentioned certain reasons for suspecting that they may prove rather to belong to the closing period of the Cretaceous. One difficulty in deciding in regard to their precise horizon is, that all of the fossils yet known from them are new and entirely distinct from those found elsewhere in very well-determined horizons. None of them belong to any of the characteristic Cretaceous genera, while several of the species are nearly allied to Lower Eocene forms of the Old World, though clearly distinct specifically.

The fact, however, that at least one species occurring here seems to be identical with a form (*Vivipara Conradi*) found in a similar brackish-water group of strata, associated with Cretaceous types of Vertebrate remains at the mouth of Judith River on the Upper Missouri, when taken in connection with the recent discovery of a Cretaceous type of Saurian remains in Wyoming, apparently at a higher horizon, and of a decidedly brackish-water group of Molluscan remains beneath a considerable thickness of Cretaceous strata at Coalville, Utah, certainly seems to indicate that these beds belong rather below than above the line of division between the latest Cretaceous and the oldest Eocene. Unfortunately, however, as I have often remarked, fresh-water and estuary shells do not generally present the same well-defined distinguishing features, if I may so speak, in each of the various geological horizons, usually observable among marine types, being often very similar from rocks of quite different ages, and again quite distinct in equivalent beds at different localities.

MOLLUSCA.
LAMELLIBRANCHIATA.
UNIONIDÆ.

Genus UNIO, Retzius.

UNIO VETUSTUS, Meek.

Plate 16, figs. 5, 5 *a*, 5 *b*, and 5 *c*.

Unio vetustus, Meek (1860), Proceed. Acad. Nat. Sci. Philad., VIII, 117; and (1876) in Col. Simpson's Report Expl. across the Great Basin of Utah, 359, pl. v, figs. 12 *a*, *b*.—White (1875), Rep. on Wheeler's collections 206, pl. xxi, figs. 12 *a*—*d*. Compare *U. priscus*, Meek and Hayden (1856), Proceed. Acad. Sci. Philad., 117.—Meek (1876), Pal. Upp. Mo., 516, pl. 43, figs. 8 *a*, *b*, *c*.

Shell of about medium size, transversely-subovate or subelliptic, the widest part being anteriorly, though young examples are narrower, with dorsal and ventral margins more nearly parallel, rather thin and moderately convex, about twice as long as high; base forming a long semi-elliptic or semi-ovate curve in adult shells, but usually straighter in the young; posterior margin rather narrowly rounded below in large specimens, and obliquely truncated in small examples; dorsal margin nearly straight, excepting in large shells, where it is more arched; anterior margin short and rounded; beaks depressed, not eroded, placed near the anterior, very neatly ornamented with small, perfectly regular, concentric ridges and furrows, that generally end abruptly behind at a small, oblique, linear, posterior umbonal ridge extending backward and downward, while midway between this and the cardinal margin there is a second similar ridge; other portions of the surface merely marked with lines of growth, which sometimes assume a subimbricating appearance near the free margins. Hinge of moderate length, with two cardinal teeth in the left valve, the posterior one being larger than the other; lateral teeth long and nearly straight (cardinal teeth of right valve unknown); scars of anterior muscles deep and irregularly pitted.

Length of a large specimen, about 4 inches; height, 2.23 inches; convexity, about 1.10 inches.

Young specimens of this species seem to be generally proportionally narrower, and have the posterior margin more distinctly truncated, while the costæ or concentric ridges of the beaks cover proportionally more of the umbonal region. In large examples, these markings become obsolete, excepting on the immediate umbones, and the posterior margin is more round or less distinctly truncated, while the valves become proportionally less depressed in general outline. I have long suspected that this shell may possibly be identical with *U. priscus*, M. & H., as the specimens seem to be very much alike. Still, as we only know the latter from very imperfect specimens, while the Bear River beds from which the form here under consideration was obtained, seem to be very local, and, so far as yet known, to contain a peculiar fauna, almost without exception unknown in the Upper Missouri country where the type of *U. priscus* was discovered, it is perhaps better to keep these two proposed species separate until we can have an opportunity to compare better series of specimens from the two distantly separated localities.

Locality and position.—Fresh-water beds on Bear River, near the mouth of Sulphur Creek, Wyoming.

UNIO BELLIPLICATUS, Meek.

Plate 16, figs. 4, 4 a.

Unio belliplicatus, Meek (1870), Proceed. Philosophical Society of Philadelphia, XI.

Unio (Loxopleurus) belliplicatus, Meek (1873), Hayden's Second Report Geol. Survey of the Territories, 294.

Shell attaining a medium size, transversely subovate, the widest part being a little in advance of the middle, moderately convex, generally less than twice as long as high; anterior margin short, rather regularly rounded; posterior margin obliquely-subtruncated, with a more or less convex outline, most prominent below, where it is obtusely subangular or abruptly rounded into the base; dorsal outline nearly straight, or more or less arched; base broad-semiovate, being most prominent in advance of the middle, in large specimens generally a little sinuous posteriorly; beaks much depressed, or scarcely rising above the cardinal margin, oblique, and placed near the anterior end, not eroded; hinge moderately long, with car-

dinal and lateral teeth, so far as known, much as in the last-described species. Surface ornamented by a series of very regular, distinctly-defined, and generally simple plications, which commence very small, and closely approximated along the dorsal margin just before the beaks, and after slight curves, radiate and descend obliquely toward the posterior basal margin, increasing in breadth and becoming more obtuse as they descend and diverge, and at last in large specimens becoming obsolete before reaching the margins; while another more or less similar series of plications sometimes originates along the cardinal margins behind the beaks, and descends obliquely backward and downward, so as to connect with those of the first-mentioned series along the posterior umbonal slopes at very acute angles, somewhat like we see on species of *Goniomya*. Marks of growth moderately distinct, becoming sometimes stronger or subimbricating near the margins.

Length of a large specimen, 2.75 inches; height, 1.50 inches; convexity, about 0.85 inch.

This beautiful species may be distinguished at a glance from the last by its peculiar plications, the principal series of which, although originating, as in that species, just before the beaks, always radiate obliquely backward and downward *across* the lines of growth, instead of running horizontally backward parallel to those lines. The fact that these plications do not converge to the beaks will serve to distinguish this shell from another associated species, of which there are fragments in the collection, with a series of very prominent plications converging more nearly to the apex of each beak. In the latter, the beaks are also much more gibbous.

In its style of ornamentation, this species seems to approach South American types, such as *U. hylea* and *U. Guaraniana*, more nearly than any of the numerous North American forms. Its radiating plications remind one of the genus *Castalia*; but its form and hinge are entirely different, the latter being that of true *Unio*.

In Dr. Hayden's Second Annual Report of the Geological Survey of the Territories, page 294, published in 1872, I proposed a subgenus *Loxopleurus*, for the reception of this species, which it can retain, if it shall be considered desirable to separate it subgenerically or otherwise from the typical and other established sections of the genus *Unio*, on account of its very peculiar

surface-markings or other characters. My present opinion, however, is, that it may find a place in some of the previously-proposed sections of *Unio*.

Locality and position.—The typical specimens of this species were brought by Dr. Hayden from Limestone Hill, on Bear River, Utah. Mr. King also found it on the same river, beneath indications of lignite. Specimens were also sent by Mr. H. R. Durkee to the Smithsonian Institution, from the same horizon at Gilmer, Wyoming.

CYRENIDÆ.

Genus CORBICULA, Benson.

CORBICULA (VELORITINA) DURKEEI, Meek.

Plate 16, figs. 6, *a*, *b*, *c*, *d*, *e*, *f*, *g*.

Cyrena (*Corbicula*?) *Durkeei*, Meek (1870), Proceed. Acad. Nat. Sci. Philad., XI, 431.

Corbicula (*Veloritina*) *Durkeei*, Meek (1872), Hayden's Second Ann. Report U. S. Geol. Survey of the Territories, 294.

Cyrena (*Veloritina*) *Durkeei*, White (1876), Report on Lieut. Wheeler's collections, 207, pl. xxi, fig. 13.

Shell attaining a large size, thick, trigonoid-subcordate, gibbous, oblique, with length exceeding somewhat the height, most convex a little in advance of and above the middle, and cuneate postero-ventrally; posterior dorsal slope long, straight, or slightly convex in outline from the umbones to the angular or subangular posterior basal extremity; basal margin semi-ovate in outline, being most prominent anteriorly; anterior margin short, descending very abruptly from the beaks, with a slightly concave outline above, and rounding regularly into the base below; beaks elevated, gibbous, obliquely incurved, contiguous, and placed about half-way between the middle and the anterior end, or sometimes nearly over the latter; posterior umbonal slopes prominently rounded, with posterior dorsal margins inflected or incurved so as to form a profound, broad concavity, or sulcus, along their entire length, as the two valves are seen united; lunule in most cases deep, but generally without well-defined margins; ligament short, narrow, and so deeply seated in the broad dorsal concavity as not to be visible in a side-view when the valves are united; surface only showing moderately distinct lines of growth; hinge strong; cardinal teeth oblique, excepting the anterior

one, which ranges nearly vertically; lateral teeth elongated, and only very minutely striated, or very nearly smooth, the posterior one of the left valve being sometimes mainly formed by the beveling of the inflected edge of the valve, instead of standing out at right angles from an erect margin; pallial line with a short, very shallow sinus, immediately under the ovate, shallow, and oblique scar of the posterior adductor muscle (see fig. 6 *g*); anterior muscular impression deeper, slightly smaller than the other, and ranging nearly vertically.

Length of a large specimen, 1.78 inches; height, 1.56 inches; convexity, 1.12 inches.

As may be seen by our figures, this shell varies greatly in form, some specimens being more depressed, with the posterior basal extremity more produced than in others (see fig. 6 *b*); while others have the umbones more elevated, and the whole shell proportionally shorter, as seen in our fig. 6 *c*. Still other specimens, that seem to be younger examples of this species, are proportionally both more compressed and more depressed, with a more nearly ovate outline, as represented by fig. 6 *f*. It is possible that the latter may belong to a distinct species; but my present impression is that it can hardly be separated from the others, as there seem to be all intermediate gradations of form and size.

Some varieties of this species look almost exactly like a Lower Lignite Paris Basin species, described by Deshayes under the name *Cyrena Forbesi* (see plate xxxvii, figs. 24 to 26, Descr. des An. sans Vert., Bassin, Paris, 1), particularly as seen in a side-view of the exterior. Deshayes' species, however, is a thinner shell, with a weaker hinge, and has its lateral teeth more strongly striated, and the posterior dorsal margins of the valves not near so strongly inflected; while its umbonal slopes are less prominently rounded, and it wants the small sinus of the pallial line seen in our species. In its greater thickness, more trigonal form, and prominent umbonal slopes, our shell agrees more nearly with another species described by Ferussac under the name *Cyrena antiqua*, and figured by Deshayes (from the Lignite beds of the Paris Basin) on plate xviii of his "Coquilles Fossiles des Environs de Paris". The latter species, however, is proportionally shorter, with still more elevated beaks, a broader hinge-plate, less

diverging cardinal teeth, and more strongly striated laterals. Its surface is also rougher, being more strongly furrowed and ridged than that of our shell, and its lunule is much larger.

Deshayes has noticed, in his later work on the Paris Basin fossils, the points of resemblance between the latter of the above-mentioned species and the existing genus *Velorita*, and yet points out some differences that indicate a transition from the typical forms of *Corbicula* toward *Velorita*, through such species as *C. antiqua*. The species here under consideration seems to me also to occupy a somewhat intermediate position between the two genera mentioned, having more nearly the trigonal form, oblique cardinal teeth, and thick solid shell of *Velorita*, while its anterior lateral teeth are as elongated and slender as in *Corbicula*. It, however, differs from both, in the peculiar incurved character of the posterior dorsal edges of its valves, so as to form a very deep concavity or furrow along their entire length, as seen when the valves are united. This inflection of the borders and the depressed nature of the ligament, bring the latter so far below the elevated umbonal slopes that it is entirely hidden from view in looking at the shell from either side, instead of projecting above the umbonal slopes, as in the two types above mentioned. Again, the posterior lateral tooth of its left valve is sometimes mainly formed by beveling of the inflected edge of the valve, instead of projecting out at right angles to an erect margin. In consequence of these peculiarities of our shell, I have already proposed to make it the type of a new section, under the name *Veloritina*, in Dr. Hayden's Report of 1872. Whether or not this section can properly include *Cyrena antiqua*, I am not well enough acquainted with that shell to decide; but, although it seems to depart from our type in some of its distinguishing characters, I am inclined to believe that it may find a place in the same group.

Locality and position.—The first specimens of this species that I have seen, were brought from the brackish- or fresh-water beds on Sulphur Creek, near Bear River, Wyoming. Soon after, Mr King's party brought in additional specimens from the same locality and beds; and, at a later date, Mr. Durkee, an engineer on the Union Pacific Railroad, sent numerous specimens of it and the associated fossils to the Smithsonian Institution, for the use of which

specimens I am indebted to Professor Henry. Dr. White has also identified it among Lieutenant Wheeler's collections from the north fork of Virgin River, Utah.

CORBULIDÆ.

Genus CORBULA, Brug.

CORBULA (ANISORHYNCHUS) PYRIFORMIS, Meek.

Plate 17, figs. 2, and 2 a, b, c, d.

Corbula (*Potamomya* ?) *pyriformis*, Meek (1860), Proceed. Acad. Nat. Sci. Philad., 312.

Corbula (*Potamomya* ?) *concentrica*, Meek (1860), ib., 313.

Corbula (*Anisorhynchus*) *pyriformis*, Meek (1871), Extract from Dr. Hayden's Second Ann. Report Geol. Survey of the Territories; and (1872) in the last-mentioned Report, 292; and (1876) in Col. Simpson's Report Expl. across the Great Basin of Utah, 359.

Corbula pyriformis, Dall (1872), Am. Jour. Conch., VII, 90.

Shell attaining a large size, rather thick, oval-subpyriform, nearly equivalve, very gibbous in the central and anterior regions, and much more compressed, narrowed, and produced posteriorly; beaks elevated, nearly equal, incurved, and placed more or less in advance of the middle; anterior side generally truncated obliquely forward above, from the beaks to near the middle, thence rounding abruptly to the base; posterior side much attenuated, and usually slightly truncated at the immediate extremity; dorsal margin generally very concave in outline behind the beaks, and provided with a well-defined marginal carina, extending in each valve from the beaks nearly to the posterior extremity, and between these carinæ with a deeply-excavated lanceolate escutcheon; basal margin deeply rounded in the central and anterior region, and more or less sinuous in outline behind the middle; lunule deeply and rather largely impressed, without being always distinctly defined, though it is sometimes margined by a subangular ridge on each side. Surface ornamented with concentric ridges and furrows, most regularly and strongly defined on the umbonal region, and gradually becoming more irregular and less distinct toward the basal margin, or in some cases entirely fading away, so as to leave only the lines of growth over the whole exterior. Hinge with the tooth of the right valve rather thick, prominent, subtrigonal, striated, and a little curved upward; cartilage-pit deep and trigonal; hinge of left valve, with pit and cartilage-process, presenting the usual characters; pallial line with apparently a small shallow

sinus; posterior muscular impressions very faintly marked; anterior muscular impressions generally well defined, subovate, attenuated, and curving backward above where they connect with the small scars of the pedal muscles.

Length of a medium-sized specimen, 1.33 inches; height of the same, 0.87 inch; convexity, 0.78 inch.

This species varies considerably in form, as well as in surface-markings. In some specimens, the whole surface is nearly smooth or only marked with obscure lines of growth (fig. 2a); while, in others, the most gibbous part of the valves and the umbones are marked with very regular, distinct, concentric ridges and furrows (fig. 2). In still others, the ridges and furrows are exceedingly irregular and very strongly marked (fig. 2c). There are also more or less marked differences in the elevation of the beaks, the convexity of the anterior region, and the proportional length of the attenuated posterior extremity. Yet all of these varieties blend together by such slight shades of difference that it seems impossible to find constant characters by which they can be separated specifically.

In first describing this species, from the few imperfect specimens originally brought from the Far-West, I was led to believe that there were two distinct species represented among them; one nearly smooth, which I called *Corbula pyriformis*, and another with regular, concentric ridges, for which I proposed the name *C. concentrica*. The extensive series of specimens, however, brought in by various explorers from the same locality, soon led to the conclusion that the two types really belong to one variable species.

None of the specimens originally studied were in a condition to give any clue to the nature of the hinge; but, from the fact that they were found associated with some fresh-water shells, it seemed quite probable that they belonged to the brackish-water group *Potamomya*, or more properly *Azara*, and for that reason I placed the name *Potamomya*, with a mark of doubt, parenthetically between the generic and specific names. Some years later, however, when large numbers of fine specimens of this shell were at hand for study, I succeeded in working out the hinge, and found that it does not

present the characters of *Azara* at all, but seems to agree almost exactly with that of *Corbula* proper. From this fact, and its apparent fresh- or brackish-water habits, I at first thought it might possibly find a place in a newly proposed South American group for which Mr. Gabb used the name *Pachydon* (but afterward named *Anisothyris* by Mr. Conrad, because *Pachydon* had been previously used by Sowerby for another genus), some species of which closely resemble the shell under consideration; while the South American type differs little from *Corbula* in its hinge-characters.* Soon after, on informing my friend Mr. Conrad that I had found our shell to differ in its hinge from *Azara*, and to agree almost exactly with *Corbula*, he wrote to me that he had been studying specimens of the same, sent to the Academy of Sciences from the original locality, and that he had proposed, in manuscript, to make it the type of a new genus *Anisorhynchus*, founded mainly on its brackish- or fresh-water habits, *Neæra*-like form, and supposed gaping posterior; and I adopted his name in a subgeneric sense, in an extract from Dr. Hayden's Second Annual Report, then just ready to go to press, as well as in the report itself, printed a month or two later.

After examining hundreds of specimens of this shell, however, I have failed to detect any evidence that its valves were in the least gaping; and, as regards its *Neæra*-like form, there is an objection to giving very much weight to it as a distinguishing character, that is the fact that *Corbula alæformis* Gabb, from marine beds, has exactly the same general form; so that, so far as yet known, the group *Anisorhynchus* seems to rest entirely upon the apparent brackish-water habits of our shell. There are not known at present any well-determined fresh-water living species of *Corbula*; but Dr. Stoliczka says (Palæont. Indica, III, p. 35) that there certainly are Indian brackish-water species which cannot be distinguished from true *Corbula*, excepting that they are thinner and *Neæra*-like in form.

From all that is therefore yet known in regard to the characters of this

*Originally, *Anisothyris*, Conrad, or *Pachydon*, Gabb, was supposed by both of those authors to have an external ligament; but, on examining a series of the type-species, I found that it really has an internal cartilage like *Corbula*, with only a more oblique cartilage-process. Hence Mr. Conrad now rests the group mainly on its brackish-water habits, the subspiral character of the beaks, and the presence, in *some of the species*, of an obscure rudimentary posterior lateral tooth.

shell, I am of the opinion that it is most probably not more than subgenerically distinct from *Corbula* proper. As I have elsewhere stated, we have (at present) reason to believe that in this internal region of the continent, the changes from marine conditions, first to comparatively large areas of brackish-water, then to more restricted bodies of fresh-water, were so gradual, as the continent was slowly rising at about the close of the Cretaceous, and the beginning of the Tertiary periods, that probably a few types of *Mollusca*, originally exclusively marine in their habits, may have gradually adapted themselves to a brackish-water habitat.

The most characteristic specific features of this shell are its large size, very nearly equal valves, gibbous anterior, attenuated or subrostrate posterior extremity, and incurved, equal, and rather oblique beaks. In most specimens, the valves seem to be almost exactly equal, though usually a close examination reveals the fact that the right valve is a little larger than the other; although the immediate apex of its beak curves in under that of the left valve, and seems to be placed very slightly farther forward.

I have been inclined to think that the species described from the California Cretaceous by Mr. Gabb, in vol. ii of the California Palæontology, under the name *Corbula alæformis*, may be somewhat nearly related to this species. At any rate, certain varieties of our shell seem to agree very closely with Mr. Gabb's figure and description of his species. Most of our specimens are more coarsely furrowed and ridged; but, as already stated, they vary greatly in this respect, so much indeed, that it is difficult to know how far we can rely on this character in distinguishing Mr. Gabb's species from our type, especially as he has figured only a single specimen. The fact, however, that our shell is apparently only found associated with fresh-, or perhaps in part, brackish-water types, while Mr. Gabb's came, if I am not mistaken, from a marine deposit, would favor the conclusion that there were developed sufficiently marked differences to constitute specific, if not more important, distinctions.

Locality and position.—The original type-specimens of this species were brought by Colonel Simpson's party from Sulphur Creek, near Bear River, Wyoming. The Union Pacific Railroad there cuts directly through a small ridge composed of the upturned strata of the estuary beds containing this

and various fresh- and some brackish-water shells, which occur there by millions. Dr. Hayden's and Mr. King's parties have brought large collections of these shells from this locality; and Mr. Durkee, an intelligent civil engineer, sent great quantities of them to the Smithsonian Institution. I have, as elsewhere stated, referred these beds to the Lower Eocene; but they may yet prove rather to belong to the latest Cretaceous, as suggested by me in Dr. Hayden's Reports, and in the Upper Missouri Palæontology.

CORBULA (ANISORHYNCHUS ?) ENGELMANNI, Meek.

Plate 17, figs. 1 and 1 a.

Corbula (Anisorhynchus ?) Engelmanni, Meek (1860), *Proceed. Acad. Nat. Sci. Philad.*, XII, 312.

Shell subovate, moderately gibbous, nearly equivalve; anterior margin rather narrowly rounded; base forming a semi-ovate curve, with the most prominent part in advance of the middle; posterior more or less narrowed and compressed, with the immediate extremity slightly truncated; beaks rather depressed, nearly or quite equal, and placed a little in advance of the middle; dorsal outline sloping gradually before and behind the beaks toward the extremities, with a shallow marginal furrow extending from the beaks posteriorly; lunule excavated, but not sharply defined. Surface with small, more or less regular, concentric furrows and striæ.

Length of the typical specimen, 0.50 inch; height, 0.20 inch; convexity, 0.20 inch.

Since seeing how greatly the preceding species varies in form and other characters, I am led to suspect that this may be only a young or more depressed form of the same shell. Its greatest differences, aside from its generally smaller size, are its less gibbous form, more depressed beaks, placed a little farther backward, and its proportionally less attenuated posterior, with its dorsal margin merely sloping backward from the beaks without being concave in outline. Although with my present impressions of the variable character of *C. pyriformis*, I should hesitate to separate the form under consideration from that species, if I were now for the first time investigating these shells, as it has already been described under another name, it may be better to keep them separated until we can have an oppor-

tunity to study the development of the young of *C. pyriformis* through its various stages of growth.

This form resembles Mr. Gabb's *C. Hornii*, though not so closely as the last resembles his *C. alæformis*.

Locality and position.—Bear River, mouth of Sulphur Creek, Wyoming, from the same horizon as the last.

GASTEROPODA.

AURICULIDÆ.

Genus RHYTIPHORUS, Meek.

(*ῥυτίς*, a wrinkle; *φορός*, to bear.)

Rhytiphorus, Meek (1873), Hayden's Sixth Ann. Rep. U. S. Geol. Survey of the Territories, 478.

The type of this group has the general aspect of *Melampus*, excepting that it has a series of small, oblique, short folds around the top of the somewhat shouldered whorls; while a slight curve in these little folds or costæ indicates the presence of a faint sinus in the lip near the suture, somewhat as in *Schizostoma*, Lea, but much less deeply defined. It has two folds on the columella, while the outer lip is thin, and apparently entirely smooth within.

Type *Melampus priscus*, Meek, which is the only species known.

RHYTIPHORUS PRISCUS, Meek.

Plate 17, figs. 6 and 6 a.

Melampus priscus, Meek (1860), Proceed. Acad. Nat. Sci. Philad., XII, 315.

Rhytiphorus priscus, Meek (1876), Col. Simpson's Report Expl. across the Great Basin of Utah, 364, pl. v, figs. 4 a, b.*

Shell obovate, about once and a half as long as wide; spire depressed-conical; whorls about five, convex, or faintly subangular; last one large, somewhat shouldered above, and tapering below the middle; suture well defined; surface marked by rather obscure lines of growth, and the small, regular, vertical, or slightly oblique folds, which are distinct on the volutions of the spire, and around the upper edge of the body-whorl, but obsolete on all the surface below this; aperture narrow, angular above, and apparently very narrowly rounded below; outer lip sharp and apparently smooth

* These are better figures than those here given.

within; columella provided with one rather strong oblique fold below, and a much smaller less oblique one about half-way up the aperture.

Length, about 0.77 inch; breadth, 0.50 inch; apical angle nearly regular, divergence about 80° .

I know of no other shell so nearly allied to this as to render a comparison necessary. Its most striking character is the presence of the little folds around the upper part of its body-volution and on those of the spire. These will at once distinguish it from any type of the *Melampinæ* known to me, even in specimens not in a condition to show any of the other characters.

Locality and position.—The only three specimens of this species I have seen were found by Colonel Simpson's party in the brackish-water carbonaceous beds at the mouth of Sulphur Creek, on Bear River, Utah.

CERIPHASIIDÆ.

PYRGULIFERA HUMEROSA, Meek.*

Plate 17, figs. 19, 19 a, and wood-cut fig. 6.

Melania humerosa, Meek (1860), Proceed. Acad. Nat. Sci., XII, 313.

Tiara humerosa, Meek (1866), in Conrad's Smithsonian Check-List of Eocene and Oligocene Fossils, 12.

Pyrgulifera humerosa, Meek (1872), in Dr. Hayden's Second Ann. Report Geol. Survey of the Territories, 294 and 299; and (1876) in Col. Simpson's Report Expl. across the Great Basin of Utah, 363, pl. v, fig. 6 a, b, c.

Shell attaining a rather large size, moderately solid, ovate-subfusiform; spire prominent, distinctly turreted; volutions five and half to about seven,

* This genus is related to *Lithasia*, as originally defined by Professor Haldeman, and presents the following characters:

Shell subovate, thick, imperforate; spire produced, turreted; volutions angular, shouldered, and nodular above; surface typically with vertical ridges and revolving markings; aperture subovate, faintly sinuous, but not notched or distinctly angular below; outer lip prominent in outline below the middle, retreating at the base, and subsinuous at the termination of the shoulder of the body-volution above; peristome continuous; inner lip a little callous below, and thickened all the way up, but without a protuberant callus above, sometimes with a shallow umbilical furrow along its outer margin below.

Differs from *Lithasia*, Haldeman, in not having its aperture distinctly angular and notched, or subcanaliculate below, in wanting a protuberance at the top of the inner lip, and in having a more produced, distinctly turreted spire, as well as very different surface markings.

angular and strongly shouldered, the upper surface being flattened or a little

Fig. 6.



Pyrgulifera humerosa.

Showing the aperture much better than the specimen figured on the plate.

concave, with usually a slight outward slope from the suture to the angle or shoulder, where it meets the vertical outer surface nearly at right angles; last or body-volution large, or generally composing about two-thirds the entire bulk and length of the shell; suture well defined by the prominence and angularity of the volutions, but not channeled. Surface of each turn ornamented by about ten to fifteen rather strong, vertical, or slightly oblique folds, or costæ, each of which terminates in a small nodular projection at the shoulder above, so as sometimes to impart a subcoronate appearance to the same, while they all become nearly or quite obsolete below the middle of the body-volution; vertical costæ crossed by smaller, but quite distinct revolving, raised lines, or small ridges, some four to six of which may be counted on the outer surface of each turn of the spire, and about ten on the body-volution, where they increase in size downward; upper flattened surface of the volution generally only marked by the moderately distinct lines of growth seen below; aperture obliquely rhombic-subovate, being higher than wide, rounded-subrectangular above, and narrowed and more or less angular, with a slight sinus or notch, at the connection of the outer and inner lips near the middle below; columella arcuate; inner lip, in mature specimens, rather thick all the way up, but more so below, where it is somewhat reflected and margined by a slight, revolving umbilical furrow, with usually an angular outer margin; outer lip sharp, prominent near the middle, and retreating below and at the angle of the whorls above.

Length of the largest specimen seen among hundreds, 1.63 inches; breadth, 0.90 inch; height of aperture, 0.81 inch; breadth of same, 0.50 inch.

All of the specimens of this shell first studied, as well as all those for some years after brought in, had the outer lip and lower part of the columella broken away, so that no very clear idea of the nature of its aperture and the connection of its outer and inner lips below could be formed from them; while, in all its characters that could then be determined, it so closely

* These revolving ridges are represented too coarse in the above figure.

resembled the typical forms of the foreign genus *Melania* (= *Tiara*) that I was led to refer it to that group. At last, however, a fine, large, nearly perfect specimen was brought from the original locality, and this at once showed that the outline of the lower part of its aperture is more angular, and its inner lip more thickened below than in the *Tiara* group; the whole combination of characters being more nearly as in *Lithasia*, but still evidently different from that genus. Consequently, in Dr. Hayden's Second Annual Report, I proposed to found a new genus *Pyrgulifera*, for its reception; which name I now retain for it.

Among the Old World fossil species, this shell seems to be most nearly represented by *Melania armata* of Matheron, from the Lower Eocene lignite beds at the mouth of the Rhône, in the southeast of France (see Cat. Méth. Corps Org. Foss. du Départ. des Bouches-du-Rhône, pl. 37, figs. 11, 12, and 13). It differs, however, in the form of its aperture, as well as in having the vertical folds, or costæ, on all of the volutions of the spire and the upper flattened part of its whorls nearly or entirely without revolving lines; while those below the angle of *M. armata* are finer and more numerous than on our shell, which also has its inner lip generally thicker below.

Locality and position.—Sulphur Creek, near Bear River, Wyoming, directly on the Union Pacific Railroad, where it occurs in the upheaved beds in great numbers, along with numerous fresh-water and perhaps some brackish-water shells, belonging to the horizon of the latest Cretaceous or oldest Tertiary.

VIVIPARIDÆ.

Genus VIVIPARUS, Montfort.

VIVIPARUS CONRADI, Meek and Hayden.

Plate 17, figs. 18 and 18 a.

Paludina Conradi, Meek and Hayden (1856), Proceed. Acad. Nat. Sci. Philad., VIII, 112.
Viviparus Conradi, Meek (1866), in Conrad's Smithsonian Check-List, 12.

Shell subtrochiform; spire conical, moderately prominent, abruptly pointed at the apex; volutions five or six, flattened nearly to the slope of the spire; last one rather distinctly angular around the middle in young shells, but more obtuse in the adult; suture generally merely linear. Sur-

face marked with fine oblique lines of growth, which, in well-preserved specimens, are sometimes seen to be crossed on the upper volutions by traces of minute revolving striæ, scarcely visible without the aid of a magnifier. Aperture rhombic-subcircular; columella rather deeply sinuous in the umbilical region; axis imperforate.

Length of an adult shell, about 1 inch; breadth, 0.70 inch; length of aperture, 0.44 inch; apical angle nearly regular, or with slightly convex slopes, divergence 54° .

The above description was made out from the typical specimens from the Upper Missouri country near the mouth of the Judith River. The example we have figured from Wyoming is quite imperfect, though agreeing well with those from the Upper Missouri in all respects, so far as its condition affords the means of comparison. Being so far as yet known *apparently* common to these two distantly separated localities, I have thought it desirable to give a figure of it, notwithstanding the imperfect condition of the specimen. The identity of the Bear River specimen with the true *V. Conradi* cannot be regarded as positively demonstrated.

Locality and position.—Mouth of Sulphur Creek, on Bear River, Wyoming, at the same horizon as the last; Museum of the Smithsonian Institution, Colonel Simpson's collection.

Genus CAMPELOMA, Raf.

CAMPELOMA MACROSPIRA, Meek ?.

Plate 17, figs. 17 a, b.

Melantho (Campeloma) macrospira, Meek (1872), Hayden's Second Ann. Report U. S. Geol. Survey of the Territories, 299.

Compare *Turbo paludinæformis*, Hall (1845), Frémont's Report Expl. Rocky Mts., 309, pl. iii, figs. 13 and 13 a.

Shell ovate, of medium size; volutions about five or six, convex, increasing rather gradually in size, and without revolving ridges or angularities; spire moderately prominent, conical, and not eroded at the apex; suture distinct in consequence of the convexity of the volutions; surface with fine, obscure, slightly sigmoid lines of growth; aperture ovate; inner lip somewhat thickened below.

Length, about 0.95 inch; breadth, 0.60 inch; length of aperture, 0.45 inch; breadth of aperture, 0.30 inch.

I have been inclined to refer this shell to *C. paludinæformis* (= *Turbo paludinæformis*, Hall), figured in Frémont's Report; but the fact that that species is said to be associated with *Goniobasis nodulosa* (= *Cerithium nodulosum*, Hall), in a light-colored "Oölitic limestone", seems to be a very strong objection to the conclusion that it can be the species here under consideration; the latter being from dark, carbonaceous, shaly and arenaceous beds, probably belonging to a very different horizon. I have seen specimens believed to belong to *G. nodulosa*, in a light-colored matrix from this region, densely packed with *Cypris*, presenting much the appearance of oölitic particles; but these came from an entirely different formation, containing a different group of fossils from those found in the strata from which the shell under consideration was obtained. In size and general appearance, our shell is not very unlike Professor Hall's figures of *C. paludinæformis*; but still it has a less oblique suture and more convex volutions.

The form here described agrees well with many specimens now before me from the same locality and beds, which specimens I think most probably medium-sized examples of *C. macrospira*, founded on a much larger, more elongated shell; but, as they may possibly be distinct, I have merely referred them provisionally to that species. In order to facilitate comparison, I give below a description of *C. macrospira*, from the original typical specimens:

Campeloma (Melantho) macrospira, Meek.—Shell attaining a rather large size, conoid-subovate; spire elongate-conical; volutions five or six, moderately convex; suture deep, rather oblique; body-volution larger in proportion to the others than would be formed by the regular rate of increase of those above, and obliquely produced below; aperture comparatively large, ovate; inner lip rather thick, arcuate, a little reflexed, but not covering the deep umbilical indentation, in old shells rather distinct from the body-volution all the way up; surface only showing the usual slightly sigmoid lines of growth. Length, about 1.80 inches; breadth, 1.14 inches.

The form here referred to *C. macrospira* seems to agree pretty well in size and proportions with the upper three or four volutions of that shell;

though it still has a rather less oblique suture. The body-volution of the adult *C. macrospira*, however, is suddenly, and disproportionally enlarged, and so oblique as to give a rather different aspect to the whole shell.

Locality and position.—Same as foregoing.

CAMPELOMA (undt. sp.).

Plate 17, figs. 15 *a*, *b*, and 16 *a*, *b*, *c*.

Shell ovate, attaining a medium size; volutions about five or six, convex, rounded, increasing moderately in size, all without revolving angles; spire moderately prominent; suture well defined, in consequence of the convexity of the volutions; surface showing fine, slightly oblique, somewhat sigmoid lines of growth; aperture ovate; inner lip apparently a little thickened, and in adult shells somewhat reflexed below, but leaving a small umbilical pit uncovered.

Length of one of the larger specimens, about 1.45 inches; breadth, about 0.95 inch.

Our fig. 15 *a* does not give a correct idea of the form of the aperture, which, in the specimen figured, is filled with rocky material that laps upon the columella, so as to give an unnatural apparent breadth to the mouth of the shell. The engraving also makes the marks of growth *much* too coarse and too straight on fig. 15; and the specimen is compressed accidentally, so as to appear broader than natural. It may, therefore, be only a distorted specimen of the last; and the smaller specimens represented by figs. 16 and 16 *a*, *b*, *c* are probably young shells.

Locality and position.—Same as foregoing.

LIMNÆIDÆ.

Genus LIMNÆA, Lamarck.

LIMNÆA (LIMNOPHYSA) NITIDULA, Meek.

Plate 17, figs. 5, 5 *a*.*

Melania ? nitidula, Meek (1860), Proceed. Acad. Nat. Sci. Philad., XII, 314.

Limnæa nitidula, Meek (1866), in Conrad's Eocene Smithsonian Check-List, 9.

Shell small, ovate-subfusiform; spire conical, moderately elevated; volutions about six and a half, convex, last one forming two-thirds of the

* Fig. 5 *a* does not give a very correct representation of the aperture of this shell.

entire length; suture well defined; aperture subovate, narrowly rounded below and angular above, scarcely equaling one-half the length of the shell; columella apparently with only a very small fold, and showing by the side of the inner lip below, appearances of a small umbilical indentation. Surface marked by fine, rather obscure lines of growth, with (on some specimens) exceedingly faint traces of microscopical revolving striæ.

Length, 0.40 inch; breadth, 0.20 inch; apical angle convex, divergence 40° .

Among recent species, this may be compared with *L. humilis*, and the several forms regarded by Mr. Binney as varieties of that species. It is a decidedly more slender shell, with a less expanded aperture and less developed inner lip than Mr. Binney's figure (p. 63, fig. 99, Land and Fresh Water Shells) of an authentic specimen of that species. It agrees, however, more nearly in form with some of those figured by Mr. Binney as varieties of *L. humilis*, but still differs from them all in other details.

Locality and position.—Same as last. By some oversight, in first describing this species, the locality was wrongly given as Ham's Fork, latitude $41^{\circ} 40'$ north, longitude $110^{\circ} 10'$ west.

SPECIES OF UNDOUBTED TERTIARY AGE.

MOLLUSCA.

LAMELLIBRANCHIATA.

CYRENIDÆ.

Genus SPHÆRIUM, Scopoli.

SPHÆRIUM RUGOSUM, Meek.

Plate 16, figs. 2, 2 a, and 2 b.

Sphærium rugosum, Meek (1870), Proceed. Acad. Nat. Sci. Philad., Ap., 56.

Shell above medium size, rather gibbous, thick, quadrato-suborbicular in outline, the length being a little greater than the height; greatest convexity slightly above the middle; anterior margin more or less regularly rounded; base semi-elliptic or sub-semicircular in outline; posterior margin

generally a little wider than the anterior, and faintly subtruncated, with an anterior slope; dorsal outline rounding into the anterior and posterior margins, but more regularly into the former. Beaks not eroded, nearly central, rather prominent, and incurved, but not oblique. Surface ornamented by sharply-defined, often elevated, concentric striæ, separated by rounded furrows, in which very minute lines of growth may be seen under a magnifier; the elevated concentric striæ becoming more regular, coarser, more distantly separated, and more prominent on the umbones. Cardinal margin and lateral teeth comparatively stout.

Length of largest specimen, 0.34 inch; height, 0.30 inch; convexity, 0.28 inch.

The most marked characteristics of this species are its quadrato-suborbicular, rather gibbous form, very nearly central beaks, and particularly its sharply elevated, concentric striæ, growing stronger, more prominent, and more distantly separated on the umbones, until near the points of the same they often assume the character of sharp, raised plications. In some of the smaller specimens, these raised, rather distantly separated, stronger striæ extend over nearly the whole surface; while in others they pass gradually into mere irregular lines of growth on most of the surface, occasionally separated by wider furrows.

In form, this species is very similar to the existing *S. Vermontanum* of Prime, with which it also agrees nearly in size. It is more regularly rounded in front, however, and has stouter lateral teeth; while its concentric, raised striæ and impressed sulcations are generally larger and grow more distinct on the umbones than below, instead of the reverse. In this latter character of marking, it agrees more nearly with *S. aureum*, Prime, from which, however, it differs entirely in form.

Locality and position.—Fossil Hill, Kaw-soh Mountains, Nevada; in a white calcareous matrix of Tertiary age.

SPHÆRIUM? IDAHOENSE, Meek.

Plate 16, fig. 1 and 1 a.

Sphærium? Idahoense, Meek (1870), Proceed. Acad. Nat. Sci. Philad., Ap., 57.

Shell attaining a large size, moderately convex, rather thick in proportion to size, orbicular-subovate in outline, being wider in front than pos-

teriorly; anterior margin regularly rounded; base semi-ovate in outline; posterior margin somewhat narrowly rounded below and sloping forward above; dorsal margin short; beaks placed in advance of the middle, a little compressed, and directed obliquely forward and inward; surface marked by concentric striæ and furrows; lateral teeth stout.

Length, 0.98 inch; height, about 0.92 inch; convexity, about 0.54 inch.

The specimens of this shell are not in a very good state of preservation, being, with one exception, internal casts, and this one only retains a part of the shell. They certainly differ, however, from the last not only in their much larger size, but in being less nearly equilateral, more produced, and rather more narrowly rounded posteriorly, as well as proportionally less convex. The internal casts have the umbonal region from a little above the middle of the valves compressed. Some of these casts show a few rather distinct, broad, irregular, concentric undulations that were doubtless more strongly defined on the exterior of the valves.

None of the specimens of this shell show the hinge very clearly; but, from its large size and thickness, I was at first inclined to believe it a *Cyrena* or a *Corbicula*. Impressions in the matrix, however, show that its lateral teeth are not striated, nor of the form seen in the latter genus. Possibly I should call it *Cyrena Idahoensis*; as its pallial line is certainly simple, however, and not sinuous, as in most of the American living species, and, so far as known, in nearly all the fossil *Cyrenas* and *Corbiculas* of this continent, I have concluded to place it provisionally in the genus *Sphærium* until better specimens can be obtained for study.

Locality and position.—Same as last, and from same formation at Castle Creek, Idaho.

UNIONIDÆ.

Genus UNIO, Retzius.

UNIO HAYDENI, Meek.

Plate 16, figs. 3, 3 a, and 3 b.

Unio Haydeni, Meek (1860), Proceed. Acad. Nat. Sci. Philad., XII, 312; and (1876) in Col. Simpson's Report Expl. across the Great Basin of Utah, 364, pl. v, figs. 11 a, b.

Shell rather small, or of nearly medium size, elliptic-subovate, rather

more than once and a half as long as high, moderately convex, the greatest convexity being usually slightly above and in advance of the middle; anterior end rounded; posterior end more or less regularly rounded, being usually most prominent a little below the middle; basal margin forming a semi-elliptic curve; dorsal outline somewhat straightened, or slightly convex, along the central region, and rounding into the anterior and posterior margins, but more abruptly to the former; beaks much depressed and inconspicuous, located about half-way between the middle and the anterior margin; hinge equaling about two-thirds the length of the valves; lateral teeth rather long and nearly straight; cardinal teeth unknown. Surface smooth, excepting small striæ of growth.

Length, 1.60 inches; height, 1 inch; convexity, 0.64 inch.

This species is mainly characterized by its regular, nearly elliptic outline, inconspicuous beaks, and smooth surface. Its shorter and more elliptic form, and especially its smooth umbones, will at once distinguish it from both of the Bear River species. I have sometimes suspected that this shell might possibly be the same figured and described by Professor Hall, in Frémont's Report, page 307, plate iii, fig. 1 (not fig. 2), under the name *Mya tellinoides*. Still, that figure seems to represent a shell with a more attenuated posterior and more prominent beaks. At any rate, it may be regarded as extremely improbable that the figure cited, if correctly drawn, represents a shell even nearly related to *Mya*; and, although not agreeing exactly with any of the *known* Uniones from that region, it very probably represents a species of that genus. I greatly regret not having an opportunity to compare our western fresh-water shells with those figured in Frémont's Report, the types of which are in Albany, N. Y. I saw them all many years back; but, not being at that time interested in the study of such forms, I retained no very distinct recollection of their specific characters, while the published description is too brief to aid one much in identifying them.

Locality and position.—The typical specimens of this species were brought by Colonel Simpson from a whitish limestone, containing great numbers of *Goniobasis Simpsoni*, at Ham's Fork, near Fort Bridger, Wyoming Territory. Dr. Hayden has also obtained specimens of it from near the same locality. It belongs to the Bridger Group of the Tertiary series.

GASTEROPODA.

LIMNÆIDÆ.

Genus ANCYLUS, Geoffroy.

ANCYLUS UNDULATUS, Meek.

Plate 17, figs. 12 *a* and 12 *b*.*Ancylus undulatus*, Meek (1870), *Proceed. Acad. Nat. Sci. Philad.*, 57.

Shell thin, attaining a very large size, elliptic-oval in outline, being sometimes slightly widest a little in advance of the middle; apex much elevated, pointed, curved backward, and placed about half-way between the middle and the posterior margin; posterior slope concave; lateral slopes nearly straight; anterior slope distinctly convex. Surface marked with fine, rather obscure lines of growth, and strong, comparatively large, concentric undulations, most distinct and regular on the anterior slope, where there are sometimes very obscure traces of about three radiating ridges.

Length of the largest specimen seen, 0.67 inch; breadth of the same, 0.54 inch; height, 0.35 inch.

The specimens show some variation in their proportions, as well as in the regularity and distinctness of the undulations; the largest individual from which the above measurements were taken being proportionally a little wider and more elevated than some of the smaller ones, while its undulations are less distinctly and regularly defined. As there are various gradations, however, in these characters, I am at present inclined to regard them as mere individual modifications of one species.

Owing to the thinness of the shell, the undulations are often quite well defined on internal casts, particularly along the anterior slope.

The only North American recent species with which I am acquainted that approaches this in size is the *A. Newberryi*, described by Dr. Lea, from California. From this, the species under consideration differs in having its apex nearer the posterior, and much more pointed and curved backward. The undulations of its anterior slope also give the shell quite a different appearance.

Locality and position.—Fossil Hill, Kaw-soh Mountains, Nevada.

Genus CARINIFEX, Binney.

Subgenus VORTICIFEX,* Meek.

(Proceed. Acad. Nat. Sci. Philad., Ap., 1870, 59.)

This type differs from *Carinifex* proper in having no traces of the revolving carinæ seen on the typical species of that genus, and in having very strongly defined costæ of growth on young examples. It is also a thicker shell, with a smaller umbilicus. The first of the following species is regarded as the type of the subgenus. The group seems to be related to *Choanomphalus*, Gerstfeldt; but, as that genus was founded on minute or very small shells, quite similar to *Valvata*, it is not very probable that our type is congeneric.

CARINIFEX (VORTICIFEX) BINNEYI, Meek.

Plate 17, figs. 11, 11 a.

Carinifex Binneyi, Meek (1870), Proceed. Acad. Nat. Sci. Philad., 59.

Shell attaining a large size, depressed-subglobose in form; spire scarcely rising above the body-whorl; umbilicus large, but rapidly contracting within; volutions about three and a half, increasing very rapidly in size; those of the spire a little convex; last one forming more than nine-tenths the entire bulk of the shell, widest above, and produced below so as to form a prominent ridge, or subangular margin around the widely-excavated umbilical region; all without revolving carinæ; aperture large, obovate, being widest above and narrowed abruptly to a subangular termination below; lip remarkably oblique, apparently very slightly reflexed, and strongly produced forward above. Surface marked with extremely oblique lines of growth, which apparently sometimes form little regular costæ.

Height, 0.59 inch; breadth, 1 inch; height of aperture, about 0.50 inch; breadth of aperture, 0.54 inch.

This species differs too widely in nearly all of its characters to require comparison with *C. Newberryi*, the typical and only known living species of true *Carinifex*, which it also exceeds in size.

All of the specimens of this species in the collection are incrustated by a laminated, smooth, calcareous deposit that has to be removed before the sur-

* This name was wrongly printed *Vortifex* in the Proceedings of the Academy.

face-marking can be seen. This is continuous over the suture, and covers all the volutions of the spire. At first, I was inclined to think that it might have been secreted by the mantle of the animal enveloping the whole shell; but further examinations have led to the conclusion that it is more probably merely an inorganic incrustation precipitated over the surface after the death of the animal, as some of the other types from the same beds are similarly covered.

This shell approaches the aspect of the typical form of the genus *Carinifex*, but still wants the characteristic carinæ of that type.

Locality and position.—Same as last.

CARINIFEX (VORTICIFEX) TRYONI, Meek.

Plate 17, figs. 10, 10 a, 10 b, 10 c.

Carinifex (Vorticifex) Tryoni, Meek (Ap., 1870), Proceed. Acad. Nat. Sci. Philad., 59.
Carinifex (Vorticifex) Tryoni var. *concava*, Meek, ib.

Shell depressed-subglobose, approaching subdiscoidal, the spire being much depressed. Volutions four and a half to five, increasing rather rapidly in size; those of the spire slightly convex; last one sometimes becoming a little concave on the upper slope near the aperture, and more or less ventricose below, the most prominent part being near the rather small, deep umbilicus, into which its inner side rounds abruptly; all the whorls rounded on the outer side, and without any traces of carinæ or revolving markings; suture well defined; aperture rather large, subcircular, its height being to its breadth about as 29 to 34; lip sharp, oblique, and produced forward above, faintly sinuous at the middle of the outer side, as well as at the inner side of the base, where it is a little thicker. Surface ornamented with small, distinct, regular ridges, and much finer lines of growth, running parallel to the very oblique outline of the lip.

Height, 0.35 inch; breadth, 0.64 inch; height of aperture, 0.29 inch; breadth of aperture, 0.34 inch.

This shell differs from the foregoing species in its smaller size, more rounded, less rapidly enlarging whorls, more prominent spire, and less excavated umbilical region. It evidently varies considerably in form and surface-markings, some of the specimens being proportionally more ventricose, or, in other words, have the body-volution, and consequently the aperture,

higher in proportion to breadth than the others, while more or less difference in the elevation or depression of the spire is observable. The most marked differences, however, are to be observed in the character of the surface-markings. Yet, since proposing for it a distinct name, more critical comparisons lead me to suspect that it may be only the young form, or the inner volutions of the last.

Another form, which I described as *C. Tryoni* var. *concava*, in the Proceedings of the Academy, cited above, has the spire depressed below the top of the body-whorl, so as to be a little concave. This may possibly be a distinct species, but it agrees so nearly with the typical *C. Tryoni* in nearly all other respects that I am inclined to regard it as a mere variety of this shell. It is represented by fig. 10 *c* of plate 17.

Locality and position.—Fossil Hill, Kaw-son Mountains, Nevada; Tertiary.

Genus PLANORBIS, Guttard.

PLANORBIS SPECTABILIS, Meek.

Plate 17, figs. 13, and 13 *a, b, c, d, e, f.*

Planorbis spectabilis, Meek (1860), Proceed. Acad. Nat. Sci. Philad., XII, 312; and (1876) in Col. Simpson's Report Expl. across the Great Basin of Utah, 366, pl. v, figs. 7 *a-d*.*

Shell rather large, discoidal, concave above and below, but more deeply below than above; volutions about six, increasing gradually in size, generally a little higher than wide, rounded on the periphery, more narrowly rounded below, and convex but more depressed above; each about half enveloped below, and near one-fourth above, by the succeeding turn. Surface and aperture unknown.

Greatest breadth, 0.80 inch; height, 0.26 inch; section of outer volution, 0.23 inch wide by 0.26 inch in height.

Since describing this shell under the above name, I have suspected that it may possibly be only a large variety, or more fully developed *P. convolutus*, M. & H. It has much the same form; but, as the types were found at widely different localities, and apparently at different horizons, I do not feel sure that they can be properly united under one specific name.

Locality and position.—The specimen figured was found by Colonel Simpson on Ham's Fork, Wyoming.

*These figures were drawn from better specimens than those here illustrated.

PLANORBIS SPECTABILIS var. UTAHENSIS, Meek.

Plate 17, figs. 14, 14 a, 14 b, and 14 c.

Planorbis Utahensis, Meek (1860), Proceed. Acad. Nat. Sci. Philad., XII, 314; and (1876) in Col. Simpson's Report Expl. across the Great Basin of Utah, 365, pl. v, figs. 8 a, b, c.

Shell large, discoidal; upper side nearly flat, or sometimes slightly concave in the middle; periphery rather narrowly rounded or subangular; umbilicus moderately large, rather deep; volutions five and a half to six, increasing gradually in size, wider than high, and moderately convex both above and below, each about one-half enveloped on the under side, and less than one-fourth on the upper, by the next succeeding turn. Surface and aperture unknown.

Greatest breadth of a large specimen, about 1.19 inches; height, 0.35 inch.

This form is much like the last, but differs in having a deeper umbilicus, and proportionally wider volutions, which are generally distinctly wider than high, instead of the reverse. It seems to be quite similar to *P. rotundatus* of Brongniart, from the Paris Basin; but none of the specimens show any traces of the angle around the under side of the volutions, generally seen in that shell, as illustrated by Deshayes in the supplement to his great work on the fossils of the Paris Basin. Among our known recent American species, it is perhaps most nearly represented by *P. subcrenatus* of Carpenter, from Oregon; but it evidently shows a greater number of volutions on the upper side, and certainly seems not to have had as strong marks of growth as that shell. It is true the specimens are all casts; but it seems scarcely probable that if it had ever possessed these lines there would have been no traces of them left.

The type-specimens of this form certainly have much more depressed and proportionally wider volutions than the last; and if we could be quite sure that this is not, at least in part, due to accidental pressure, there would be scarcely any reason for doubting that it is specifically distinct.

The form referred to this species by Dr. White, in his report on Lieutenant Wheeler's collections, plate XXI, fig. 8, seems to me to agree more nearly with the last.

Locality and position.—Ham's Fork, near Fort Bridger, Bridger beds of the Wyoming Territory; collections of Colonel Simpson's expedition, in Museum of the Smithsonian Institution; Tertiary. Dr. Hayden's party have also brought this shell from the same region.

Genus LIMNÆA, Lamarck.

LIMNÆA (LIMNOPHYSA) VETUSTA, Meek.

Plate 17, figs. 4, 4 a, and 4 b.

Limnæa vetusta, Meek (1860), Proceed. Acad. Nat. Sci. Philad., XIII, 314; and (1876) in Col. Simpson's Report Expl. across the Great Basin of Utah, 365, pl. v, figs. 3 a, b.

Shell small, elongate-subovate, or subfusiform; spire moderately prominent, conical, scarcely as long as the aperture; volutions five and a half to six, compressed-convex; last one not very ventricose, sometimes almost subcylindrical; suture well defined, with comparatively little obliquity; surface showing only obscure lines of growth; aperture very narrow, subovate; columella with a moderately distinct fold.

Length, 0.56 inch; breadth, 0.26 inch.

Among existing species this may be compared with *L. decidiosa* of Say, some varieties of which it quite nearly resembles. Its body-volution, however, is less ventricose, and its aperture less expanded, than we see in any of the several forms that have been supposed to be varieties of that species. It is perhaps more nearly allied to some of the real or supposed varieties of *L. humilis*, Say; though not exactly agreeing with any of them. It varies much in form.

Locality and position.—Ham's Fork, near Fort Bridger; Colonel Simpson's collection, in the Museum of the Smithsonian Institution; Tertiary.

LIMNÆA SIMILIS, Meek.

Plate 17, figs. 3 and 3 a.

Limnæa similis, Meek (1860), Proceed. Acad. Nat. Sci. Philad., XII, 314; and (1876) in Col. Simpson's Report Expl. across the Great Basin of Utah, 365, pl. v, figs. 2 a, b.

Shell small, narrow-subovate, approaching subfusiform; spire rather prominent, nearly as long as the aperture; volutions five and a half to six, convex; suture rather deep and oblique; surface showing only fine, obscure

lines of growth, scarcely visible without the aid of a lens; aperture subovate, rather narrowly rounded below, and acutely angular above; columella twisted into a moderately prominent fold.

Length, 0.39 inch; breadth, 0.19 inch; apical angle slightly convex, divergence about 38° .

This variable form is so closely allied to the last that I am nearly satisfied that it is only a variety of the same. Its chief difference consists in having the volutions of its spire a little more convex, and more drawn out, as it were, so as to give decidedly greater obliquity to the suture. It seems to be even more nearly allied to some of the more slender forms regarded by Mr. Binney as varieties of *L. humilis* of Say; though it is a decidedly more attenuated, less compact shell than that represented by Mr. Binney's figure of *L. humilis*, given on p. 63 of his "Land and Fresh-Water Shells", published by the Smithsonian Institution. There is scarcely any probability, however, that our shell is identical with any of the existing species.

Locality and position.—Same as last. Colonel Simpson's collection, in the Museum of the Smithsonian Institution.

LIMNÆA (POLYRHYTIS) KINGII, Meek.

Shell ovate; spire short; volutions about four, convex, rapidly increasing in size, last one very large and ventricose; suture well defined; aperture large, subovate; columella apparently with a moderately well-developed fold; surface ornamented by regular, distinct, vertical costæ, that are strongly defined on the body-volution, but more obscure or nearly obsolete on the spire.

Fig. 6.

Fig. 7.



Limnæa Kingii.

Fig. 6. A side-view, with outer lip restored.

Fig. 7. A slightly different view of same (nat. size).

Length, 0.73 inch; breadth, about 0.43 inch.

This species is remarkable for having its surface ornamented by very regular, vertical costæ, quite strongly defined on its body-volution. This character will readily distinguish it from any other species, either recent or fossil, known to me, and, with its other characters, forbid its reference to any of the established subgenera. In the possession of ribs, it agrees with *Pleu-*

rolimnæa, but it differs extremely in form from that type. I have therefore proposed for its reception a new subgenus under the name *Polyrhytis*.*

I have seen but a single specimen of this shell, consisting of a well-defined mould, from which a gutta-percha cast has been taken, and from this the figures and description were prepared. The specific name is given in honor of Clarence King, esq., the Geologist-in-charge of the Survey of the Fortieth Parallel.

Locality and position.—Cache Valley, Utah; Tertiary, probably of Miocene age.

CERIPHASIIDÆ.

Genus GONIOBASIS, Lea.

GONIOBASIS SIMPSONI, Meek. ✓

Plate 17, figs. 7, 7 a, 7 b, 7 c, and 7 d.

Melania Simpsoni, Meek (1860), Proceed. Acad. Nat. Sci. Philad., XII, 313.

Goniobasis ? Simpsoni, Meek (1866), in Conrad's Smithsonian Check-List, 12; and (1876) in Col. Simpson's Report Expl. across the Great Basin of Utah, 365, pl. v, figs. 1 a to 1 e.

Shell attaining nearly a medium size, elongate-conical; spire gradually tapering apparently to an acute apex, which is not eroded; volutions eight or nine, flattened or more or less convex, increasing gradually and regularly in size; last one rounded below; suture generally linear, and sometimes presenting a very slightly banded appearance, or becoming deeper as the volutions assume a more convex outline. Surface ornamented with more or less distinct, regular little vertical, or slightly arched costæ, which are crossed by small, often obscure, revolving, raised lines, usually largest and most widely separated on the lower half of the body-volution; costæ sometimes assuming a very faintly nodose appearance around the middle of the volutions. Aperture rhombic-subovate, and a little oblique, slightly sinuous at the base of the columella; outer lip somewhat sinuous above, and moderately prominent below.

Length of a mature specimen, 0.78 inch; breadth, about 0.30 inch;

* This subgenus bears the same relations to *Limnæa* proper, that *Costella*, Dall, bears to the typical forms of *Physa*. It was first proposed by the writer in the Palæont. Upper Mo., 532, 1876.

angle of spire nearly or quite regular, divergence somewhat variable, but usually about 26° .

This species seems to be very variable, particularly in its ornamentation. On some specimens, both the costæ and the revolving lines are quite distinct, while, in others, one or the other, or both, become more obscure, or nearly obsolete. Sometimes the costæ are rather closely arranged, and in other specimens they are proportionally a little larger and more widely separated. Occasionally they are somewhat more prominent, or even assume a minutely nodular appearance, around the middle of the volutions of the spire and above the middle of the last turn (see fig. 7 *d*). Where the costæ fade away, they sometimes, especially on the body-volution, merely pass into coarse, irregular lines of growth. The volutions also vary in their convexity, being sometimes flattened on a line with the slope of the spire, so as to show a merely linear suture (see fig. 7 *a*), and, in other examples, they are more convex. In one specimen in the collection, the volutions are decidedly convex. This specimen also has the revolving lines and the costæ very nearly obsolete, though small, obscure, closely-arranged costæ are seen near the upper part of the spire, and the rather strong lines of growth on the body-volution show a tendency to gather into a few irregular folds, or costæ. (See fig. 7 *c*.)

There are also in the various Tertiary beds of Wyoming forms more or less nearly like this, ranging through a great thickness of strata, and varying so much as to be with great difficulty separated from each other. In regard to their exact relations to the shell here figured, and to each other, as well as to two species figured by Professor Hall in Frémont's report, and one by Mr. Conrad in the *Proceed. Acad. Nat. Sci. Philad.*, from this region, I have not been able to arrive at any very satisfactory conclusion. Our specimens, however, certainly look very unlike Professor Hall's figures of the species described by him.

This species resembles more or less nearly several of the existing western forms; but, after careful comparisons, I have been unable to identify it with any of them. Its specific name was given in honor of Col. J. H. Simpson, of the United States Topographical Corps, who brought the typical specimens from the Far West.

Locality and position.—Ham's Fork, near Fort Bridger, Wyoming Territory, from the Bridger group Tertiary; Colonel Simpson's collections, in the Museum of the Smithsonian Institution.

MELANIIDÆ.

Genus MELANIA, Auct.

MELANIA ? SCULPTILIS, Meek.

Plate 17, fig. 8.

Melania (*Goniobasis* ?) *sculptilis*, Meek (1870), *Proceed. Acad. Nat. Sci. Philad.*, 58.
Compare *Melania Taylora*, Gabb (1869), *Palæont. California*, II, 13, pl. 2, fig. 21.

Shell of medium size, conoid-subovate; spire more or less elongate-conical, with convex slopes, the apical angle being greater in the young than in the adult, not eroded at the apex; volutions six to seven, rather distinctly convex; suture strongly channeled; aperture ovate, a little oblique, rather narrowly rounded below; lip sharp, most prominent below the middle, and slightly sinuous at the lower inner side. Surface elegantly ornamented by numerous, very regularly disposed, slightly flexuous or sigmoid, vertical costæ,* which are crossed by equally distinct and regular spiral ridges, about four of which may be counted on each volution of the spire (excepting those near the apex, which are smooth), and eight to ten on the last turn, on the under half of which they are most strongly defined; minute lines of growth may also be seen by the aid of a magnifier; costæ slightly nodulous at the points where they are crossed by the little revolving ridges.

Length, 0.62 inch; breadth, 0.27 inch.

This is a neat species, remarkable for its sharply-defined and very regular cancellated style of sculpturing. The vertical costæ are equally well defined on all the volutions, excepting those near the apex, and on the under side of the last one; while the revolving lines, or ridges, become a little more distinct on the lower part of the body-turn. Although there are nearly always four of these revolving ridges on the volutions above the last one, in a few examples as many as six may be counted on these turns; but this is due to the intercalation of a smaller one between two of the others, and

* These are represented too straight on the figure.

the exposure of another above the suture that is usually hidden beneath it by each succeeding turn.

Among the existing American species, this seems to be most nearly represented by *G. Albanyensis*, Lea. Mr. Tryon, to whom I sent a specimen of it, thinks it resembles some Asiatic species of *Melania*, and that it may possibly belong to that genus, and not to *Goniobasis*.

Since publishing a description of this shell under the name *Melania* (*Goniobasis*?) *sculptilis*, I have been led to suspect that it may not be distinct from *Melania Taylori* of Gabb, described in the California Report from the same region. Mr. Gabb's type seems to be much more slender and elongated, however, especially if his restored outline of the wanting part of its spire is nearly correctly drawn. Still, our types may be only young specimens of the same, as they are much smaller. I remember that there were with them a few larger casts and imperfect specimens from the same locality, so coated over with a calcareous deposit that their characters could not be made out. These agree more nearly in size and form with Mr. Gabb's type.

Locality and position.—Kaw-soh Mountains, Nevada; Tertiary.

MELANIA ? SUBSCULPTILIS, Meek.

Plate 17, fig. 9.

Melania (*Goniobasis*?) *subsculptilis*, Meek (1870), Proceed. Acad. Nat. Sci. Philad., 58.

Shell apparently less than a medium size; spire conical, with convex slopes; apex pointed, not eroded; volutions about seven and a half, flattened-convex; suture channeled; aperture ovate, slightly oblique, rather abruptly rounded below; margin of lip most prominent below the middle, and faintly sinuous on the lower inner side. Surface ornamented by small, regular, slightly sigmoid, vertical costæ, with an obscure revolving ridge just below, and a slight angle above the suture, to which prominences the costæ impart a somewhat crenated appearance; last turn marked with a few distinct, revolving, raised lines, strongest on the lower half.

Length, 0.43 inch; breadth, 0.19 inch; length of aperture, 0.14 inch; breadth of same, 0.10 inch.

This form differs from the last by its smaller and more crowded costæ,

less convex whorls, and the absence of revolving ridges, or lines, excepting on the body-volution, and the one just below and above the suture. As in that form, its apical whorls are smooth. The only good specimen of it in the collection is smaller than the average size of those of the last, and probably a young shell. I am now of the opinion that it is most probably only a variety of that shell; but it may be distinct.

Locality and position.—Same as last.

UNITED STATES GEOLOGICAL EXPLORATION OF THE FORTIETH PARALLEL.
CLARENCE KING, GEOLOGIST-IN-CHARGE.

PART II.

PALÆONTOLOGY.

BY

JAMES HALL AND R. P. WHITFIELD.

GENERAL REMARKS.

In studying the fossils placed in our hands, from the several Palæozoic formations occurring in the regions examined by the "Geological Exploration of the Fortieth Parallel", there are several groups of special interest noticed; but perhaps none more deserving of close attention than those from the limestones and silico-calcareous shales representing the Potsdam Period, from the White Pine and Eureka mining-districts and from Schell Creek. The peculiar interest attached to these specimens arises chiefly from the great number and variety of the Trilobitic remains, represented in the few blocks present in the collection, and their great resemblance to forms previously described from the soft, friable sandstones of the same period in the Mississippi Valley, within the States of Wisconsin, Iowa, and Minnesota. Although there is not a single species common to the two regions, yet there is such a close generic resemblance as to leave no doubt whatever of the positive identity of the formations. As yet, there have been fewer genera recognized from these far western localities than from the more eastern ones; but if the smaller number of distinct locations and the restricted space or territory over which collections have been made, as well as the small amount of material examined, be taken into consideration, it will at once be seen that the probability of the existence of as varied and equally abundant fauna is very great, especially as there are at present several undescribed, but quite distinct, forms recognized among the material in hand, but in fragments too poor for description or figures.

The species here described also present a striking resemblance to forms recognized in beds of corresponding age in the San Saba Valley, Texas, by Dr. F. Roemer, in his work on the Cretaceous formations of Texas (Kreid. von

Texas, &c.). The remarkable form there described and figured, under the name *Pterocephalia Sanctisabæ*, finds a close representative in the one here given as *Pterocephalus laticeps*, and shows the propriety of the generic separation, while the form characterized by the "slipper-shaped" glabella of Dr. Owen shows not only the wide geographical distribution of this peculiar type, which is common in the Wisconsin beds, and largely prevails in the White Pine, Eureka, and Schell Creek localities, and also occurs in the San Saba district, but also its value as a generic type, for which Dr. Owen proposed the name *Crepicephalus*, which may with propriety, we think, be retained for this widely-distributed group. The extensive geographical range of these peculiar and marked generic forms, through the western countries, is a point of great interest, and a feature that will undoubtedly be of much service in the future study of the formations over these as yet imperfectly-explored regions, as, from their strongly-marked character, they will be readily recognized, and serve as reliable guides in tracing out and locating, stratigraphically, the formations wherever they may be met with.

Besides the above, the genera *Dikellocephalus*, *Ptychaspis*, *Chariocephalus*, and *Agnostus* have been recognized in one or more species each. The Brachiopodous fauna of these localities is quite meager, both as regards species and individuals, and affords but imperfect means for comparison with that of other localities. The genus *Lingulepis* has been fully recognized, and a species, apparently referable to the genus *Obolella*, also occurs at Eureka, together with a minute species of *Kutorgina*. No other forms of life have as yet been noticed among the collections from rocks of this age within the region covered by the Survey.

A few very interesting species of Trilobites and other forms have been given from the collections from the base of Ute Peak, Wahsatch Range, Utah, which, from the evidence furnished by the Brachiopodous and Molluscan fauna, have been referred to the age of the Quebec group, together with other beds at White Pine, Nevada, and East Cañon, Oquirrh Mountains, Utah.

The Devonian formations are represented in a few localities; among the most interesting of which may be mentioned that of Treasure Hill, and the black slates near Eberhardt Mill, White Pine Mountains, Nevada. The

fossils of this last locality have a peculiar interest, from the occurrence of *Leiorhynchus quadricostatus*, Hall, a form which characterizes the black slates (Genesee Slates) at the top of the Hamilton group of New York, and also a species of *Lunulicardium* (*L. fragosa* = *Posidonomya fragosa* Meek). The occurrence of these two species, together with an *Aviculopecten*, scarcely distinguishable from *A. equilatera* (= *Avicula equilatera* H., Geol. Rept., 4th Dist. N. Y., p. 180, fig. 7), would appear to be sufficient reason for considering these shales of an earlier date than the Carboniferous, and much more nearly related to the Devonian Black Slates of New York. It is true there are black slaty layers, bearing Carboniferous fossils, immediately above them, or separated from them by only a thin bed of sandy calcareous shales, as at Eberhardt Mill; but these upper layers are lithologically quite distinct from those below, being, in fact, a bituminous limestone; and the fossils are so entirely distinct and strongly Carboniferous in character, one of them (*Cardiomorpha Missouriensis* S.) being positively identical with a well-known Coal-Measure species, that it appears to us there can be no doubt of their Carboniferous age and entire distinction from those below. The specimen of sandy calcareous shale in the collection, marked as occurring in the black slates at Eberhardt Mill, contains fragments and imperfect individuals of a *Spirifer*, resembling *S. Keokuk* H., but too imperfect for positive identification. If this specimen is authentic in its location, it undoubtedly marks a line of separation between the two beds of black slates.

Another group of fossils of considerable interest will be found figured on plate IV. These were obtained from limestones at Dry Cañon, Oquirrh Mountains; and from Ogden, Little Cottonwood, and Logan Cañons, in the Wahsatch Range, Utah, from their character we should consider them as of about the age of the Waverly group of Ohio and the yellow sandstones of Burlington, Iowa; which have been referred to the same age. Some of the species are identical with forms described from these localities, while others are very closely representative species; and all have more of a Devonian than a Carboniferous aspect. The occurrence of so many Devonian types at several localities within a limited district, and in considerable numbers, showing that it is not an accidental feature of an

isolated spot, would appear to be a matter of some importance in a stratigraphical point of view. The genus *Proetus* seldom occurs in rocks above the Devonian, but is here represented by two distinct species; one of which, *P. peroccidens*, has been recognized at three different localities. Besides the species illustrated on the plate, there are represented, in the collection from near Dry Cañon, a species of *Syringopora*, and a small-celled, closely-aggregated *Cyathophyllum*, an undetermined *Productus*, and a *Platyceras*; also what appears to be a Goniatite, but too imperfect for determination.

Above the limestone beds bearing Waverly fossils, at Dry Cañon, and separated from it by about twelve hundred feet of limestone, occurs a band of somewhat sandy calcareous shale, filled with Bryozōans, among which can be recognized a *Fenestella*, a *Polypora*, and a *Glaucanome*, together with a species of *Spirifera* too indistinct for determination; above this sandy shale there is nearly or quite another thousand feet of limestone, near the top of which occur the fossils figured on plate V. These latter are all of Lower Carboniferous forms, and mostly of known species, and interesting, as occurring in limestones without any intermingling of Coal-Measure types, a feature rarely met with in the Carboniferous localities of the Far West. The species represented are known in the more eastern localities as characteristic of several of the Lower Carboniferous divisions; but none of them occur in the true Coal-Measures, except *Productus semireticulatus*, which is a well-known cosmopolitan.

The age of the shales containing the Bryozoans is somewhat doubtful, as there are no known species by which to identify them with other localities; but the layers holding the fossils in question, and which occur just beneath the Weber quartzite, would appear to represent nearly all the divisions of the Lower Carboniferous as recognized in the Mississippi Valley. At one time, it was hoped, by Mr. Clarence King and his associates, that the Weber quartzite might prove a line of separation between the Lower Carboniferous and the true Coal-Measures; but all the localities except this one have yielded fossils of both formations, or of Coal-Measure forms only, showing a mingling of the two faunæ, as usually recognized in the Mississippi Valley and eastward, but in this locality, only the lower forms occur.

On that account, it will prove to be of very great interest in a stratigraphical point of view.

The section of the formations in the Western Oquirrh Mountains, in which Dry Cañon and Snowstorm Hill are situated, is likely to prove one of the most instructive of the Western Palæozoic localities, as in it will probably be found the most complete representation of the Palæozoic formations, extending from the quartzites of Ophir City (which are likely to prove as old as Huronian, being overlaid by shales bearing Trilobites of Primordial age) to these Weber quartzites, lying above the beds containing the Lower Carboniferous fossils. The layers of limestones between the Trilobitic shales and the limestones furnishing Waverly group fossils, two thousand feet in thickness, undoubtedly represent the Silurian and Devonian formations, and will probably, when thoroughly examined, yield fossils of these formations in some of their outcrops.

The rocks at this locality are said to change gradually, in passing upward, from a limestone to a quartzite, and above, having limestone bands interstratified. If such be the case, some of these limestones will most probably yield fossils on thorough examination, and show a gradual change from a Lower Carboniferous to a Coal-Measure fauna.

A few additional species furnished by the later collections from the Upper Coal or Permo-Carboniferous beds of the Weber River section, will be found figured on plate VI.

On plates VI and VII are given a few forms each of Triassic and Jurassic species. The later collections from these formations are rather unsatisfactory in their character, and not very abundant. There is one group, however, of special interest, labeled as coming from Shoshone Springs, Augusta Mountains. Of the age of these beds we are not at all satisfied. Mr. King and his associates are inclined to place them as low as Jurassic or even Triassic. This view may be correct. The species are all of undescribed forms, and therefore of but little stratigraphical value. The generic value of the *Aviculopecten*-like shell would indicate an age at least as great as this, if the generic reference is correct, about which there may possibly be some doubt; but the features of some others would incline one to believe them of much more recent date, especially the two described under the new generic name

of SEPTOCARDIA. These shells have the general aspect externally of the genus *Cardita*, and resemble very closely the forms of that genus peculiar to the Eocene formations. Since, however, they prove to be a new generic type, they cannot be said to possess the same stratigraphical importance as one already known to be peculiar to any definite horizon, and they may be only the first appearance of what afterward becomes a common feature of a group, characterizing a later period. Several fragments of additional species, all apparently new to science, occur in the collections from this locality, but all in too imperfect a condition to be serviceable.

Among the collections are many small groups of species from various localities, which would have been of great interest, and highly advantageous to science, could they have been illustrated, but the limited time and means at our disposal would not permit.

FOSSILS OF THE POTSDAM GROUP.

BRACHIOPODA.

Genus OBOLELLA Bill.

OBOLELLA DISCOIDA n. sp.

Plate I, figs. 1-2.

Shell very small, discoid, and scale-like; valves depressed convex; the larger one a little longer than wide, giving a very short, ovate form, only perceptibly narrowing toward the beak, rounded on the sides and a little straightened on the front margin; surface slightly convex, more convex on the umbo and flattened toward the front. Smaller valve circular, sometimes almost truncate at the beak, slightly convex on the umbo, and flattened in front, having a less degree of convexity throughout than the other valve.

Surface-structure not observed. The shells are all more or less exfoliated by separation from the rock. The substance of the shell is calcareous, and the surface of the cast smooth and shining, with very fine concentric lines.

The shells seldom measure more than an eighth of an inch in their greatest diameter, and are usually smaller; while the largest examples seen do not exceed one-sixth of an inch. It is remarkable only for its small size and flattened form, possessing no salient features by which it can be compared with other species.

Formation and locality.—Quite common in some hard, sandy limestones of the Potsdam formation, in the Eureka District, Nevada, associated with *Kutorgina*, *Agnostus*, and several species of *Trilobites*. Collected by Arnold Hague, esq.

Genus LINGULEPIS Hall.

LINGULEPIS MÆRA n. sp.

Plate I, figs. 5-7.

Shell small, short-ovate, a little longer than wide, point of greatest width a little below the middle of the length; base regularly rounded; beak small, pointed, and slightly incurved; cardinal slopes long, diverging from the beak to below the middle of the shell, and inclosing an angle of about ninety degrees. Valves convex, a little the most ventricose above the middle of the valve; the beak of the longer valve appearing quite full and round.

Surface of the shell apparently smooth. Internal cast distinctly radiated.

The surfaces of the shells are all more or less exfoliated in separating from the matrix, and in this condition are more or less lamellose in their structure, while the layers are bright and polished. The shell in many of its features resembles *L. pinnaformis* Owen, from the Potsdam sandstones of the St. Croix River, but has not the extended beak of that species, the valves being more nearly of equal length, that of the ventral exceeding the dorsal only by the beak being pointed instead of rounded.

Formation and locality.—In hard, somewhat ferruginous, sandy limestone of the Potsdam group in the Eureka District, Nevada. Collected by Arnold Hague, esq.

LINGULEPIS ? MINUTA n. sp.

Plate I, figs. 3-4.

Shell minute, seldom exceeding a line in its greatest diameter; in form very short-ovate, the greatest width considerably below the middle of the length and narrowing to the beak, especially on the larger valve, which is apparently slightly truncate at the extremity; base broadly rounded. Valves moderately convex, but not rotund. Smaller valve nearly circular. Substance of the shell nacreous and apparently phosphatic, not presenting any appearance of having been calcareous; the exterior concentrically lamellose.

Casts of the interior of the larger valve show a sharp, longitudinal depression along the middle, extending in some cases to near the front

margin; also two shorter, widely-diverging impressions near the beak. The same features are seen in the smaller valve, except that the shorter impressions are less divergent.

There may be some doubt as to the true generic relations of this shell. Its entire phosphatic structure places it at once among the true Linguloid species, but the muscular scars are not quite like those of *Lingulepis*. We know of no species very closely resembling it with which it may be compared.

Formation and locality.—In thinly laminated siliceous and somewhat ferruginous shales of the Potsdam formation, in the Eureka District, Nevada. Collected by J. E. Clayton, esq.

Genus KUTORGINA, Billings.

KUTORGINA MINUTISSIMA n. sp.

Plate I, figs. 11-12.

Shell minute, quadrangular in outline, and a little wider than long, with a straight hinge-line nearly or quite equaling the greatest width of the shell; sides straight or slightly rounded; antero-lateral angles rounded; front margin broadly rounded or very slightly emarginate in the middle by the very faint mesial sinus of the dorsal valve. Ventral valve somewhat pyramidal, with the side formed by the cardinal area vertical; apex of the valve obtusely pointed; cardinal area triangular, about half as high as wide. Features of the area and foramen not observed. Dorsal valve convex, but much less elevated than the ventral, and having the beak obtusely rounded and rather tumid, a very little projecting beyond the cardinal line; middle of the valve marked by a very broad, shallow, and faintly-defined mesial sinus, which does not extend quite to the apex of the valve.

Surface of the shell marked by fine, elevated, concentric lines, which are sharp on the top and often interrupted in their course, coalescing or bifurcating, and appearing as if broken, giving a peculiar roughened but not lamellose surface-structure. There are also a few very faint, scarcely defined, and somewhat irregular, distant radii. This latter feature has only been observed on the dorsal valve.

The shells have all the generic features of the specimens upon which the genus *Kutorgina*, as given by Mr. Billings (Pal. Foss. Canada, vol. 1, p. 8, figs. 8 and 10; the specimen fig. 9 probably belongs to some other genus), was founded, but differs specially in the minute size of the shell. Our specimens figured measure scarcely a line in width, and are less in length; while the original of his species, which we had the pleasure of examining some years ago, considerably exceed half an inch in length. The peculiar surface-character is one that cannot be easily mistaken, and one which we do not remember to have seen on any other Brachiopodous shell.

Formation and locality.—In limestone of the Potsdam group, at Eureka, Nevada. There are also remains of shells of the same genus, but of a species two or three times the size of this one, in some green shales from East Cañon, Oquirrh Mountains, Utah. Collected by J. E. Clayton, esq.

Genus LEPTÆNA Dalman.

LEPTÆNA MELITA n. sp.

Plate I, figs. 13-14.

Shell of medium size, transversely semi-oval in form, the length equal to about two-thirds of the width; hinge-line straight, as long as the width of the shell below; sides nearly straight for a short distance below the cardinal extremities and rectangular to the hinge-line; lower lateral margins rounded; basal line regularly convex; ventral valve depressed-convex, regularly arching from beak to base, but sometimes slightly marked by a broad, shallow, not distinctly defined, mesial depression; beak low and inconspicuous; dorsal valve concave, nearly conforming to the curvature of the opposite valve, leaving but a limited space between the two. Area not definitely ascertained, but apparently quite narrow and linear.

Surface of the shell marked by distinct, strong, somewhat arching, radiating striæ, with an indefinite number of very fine intermediate ones occupying the concave spaces between the stronger, and with them forming fascicles. This feature varies very greatly in strength and number of the finer striæ in different individuals, and also in the number of stronger radii; in some cases there being only nine or ten of the strong radii on the entire

shell, while in others there may be fifteen or twenty. Concentric lines of varying strength cross the radiating lines at irregular distances.

The shell is a very pretty and strongly-marked form, and not easily confounded with any previously-known species.*

Formation and locality.—In sandy shales of Lower Silurian age, probably of the horizon of the Potsdam or Calciferous, at Eureka, Nevada. Collected by J. E. Clayton, esq.

CRUSTACEA.

Genus CONOCEPHALITES Zenker, = CONOCORYPHE Corda.

↳ Subgenus CREPICEPHALUS Owen, ? = LOGANELLUS Devine.

The following species of Trilobites possess some peculiar features, which, being common to the whole, mark them at once as a distinct generic type or group. In many of these features, they closely resemble some of the forms described under the name *Conocephalites*, from the same horizon in Wisconsin; while at the same time these peculiar characters distinguish them from the greater number of those species. They all possess more or less distinctly the “*slipper-shaped*” glabella referred to by Dr. D. D. Owen, in his generic description of CREPICEPHALUS, and all appear to have been more or less distinctly marked by three pairs of glabellar furrows, although some of them so faintly as to be seen only by the reflection of light across their surfaces. Another marked peculiarity is the great breadth of the frontal limb between the facial sutures along the anterior border, most of them widening perceptibly in front of the eyes to the anterior margin of the head, where the rim is intersected, almost at right angles with the border, by the suture-line. The great width of the fixed cheeks opposite the eye is another peculiar character of the entire group, in several cases exceeding one-half the width of the anterior end of the glabella; while in only one example, *C. (C.) unisulcatus*, is this feature reversed, and that to only a limited degree.

Among the Wisconsin species, the frontal limb is usually not wider

* *Orthis Barabouensis* Winchell, from the Potsdam sandstone near Spirit Lake, Wisconsin, specimens of which we have lately examined, is closely related to this shell, but less strongly plicated and more deeply sulcated.—R. P. W.

than the breadth across the eyes, but generally a little narrower, and the antero-lateral angles are rounded by the extreme point of the movable cheeks, which extend in front on the upper side of the carapace, while the fixed cheeks are as a general thing reduced to their minimum breadth.

Another feature which prevails throughout the entire group is the well-marked, and often strong, ocular ridges, a feature rarely noticed among the specimens from Wisconsin. The absence of this feature in these latter may, however, be in great part owing to the unfavorable material and condition of preservation, they being all casts in a loose, friable, and often coarse sand, not fitted for retaining the more faintly marked characters of the organisms;* while the matrix from these western localities is a hard and very solid limestone, containing a considerable amount of sand in some parts, and extremely difficult to separate from the organic remains.

The features above noticed are mostly those pertaining to Dr. D. D. Owen's genus *CREPICEPHALUS* as shown in the figures, cited by him as generic (Geol. Iowa, Wis, and Minn., plate 1A, figs. 10 and 18); and we see no sufficient reason why they should not be considered as of generic importance. But whether the name *Crepicephalus* shall be retained is not so readily determined. The genus *LOGANELLUS* Devine, 1863, is a very closely allied, if not identical, form; but as no entire individuals have been obtained, either from the Wisconsin or these more western localities, except of *C. (L.) Haguei*, herein described, it is impossible to satisfactorily determine their true generic relations. There would seem, however, to be no doubt in regard to the generic identity of the latter, or of *C. (L.) quadrans*, with *Loganellus Logani* Devine, and from the great similarity of these to the dismembered parts of the other species, we are inclined to consider them as all pertaining to one genus.

CREPICEPHALUS (LOGANELLUS) HAGUEI n. sp.

Plate II, figs. 14-15.

Body broadly ovate in form, widest across the base of the head, broadly rounded in front and rapidly tapering behind to the small pygidium, strongly trilobed and moderately convex.

*Since this matter has been in the printers' hands, I have examined many freshly collected specimens from several localities of this formation in Wisconsin, and find, on most of them, the ocular ridges strongly marked.—R. P. W.

Cephalic shield semicircular forward of the occipital line, the posterior extremities extending in rather broad spines, which reach to the fifth or sixth thoracic segment, and when in their normal condition are nearly parallel to the axial lobe, but are usually spread out laterally by the flattening of the head.

Glabella rather small, rounded-conical, narrowing gently from the occipital furrow forward; front regularly rounded; surface depressed-convex, marked by three pairs of transverse furrows, which extend rather more than one-third of the distance across the glabella, and are strongly curved backward at their inner ends; occipital furrow broad and shallow; occipital ring narrow. Fixed cheeks narrow at the eye, separated from the glabella by rather distinct furrows. Frontal limb long, about half as long as the glabella, strongly and nearly equally concavo-convex; posterior limb narrowly triangular, reaching about two-thirds of the width of the movable cheeks.

Movable cheeks of moderate size, irregularly triangular, distinctly notched at the inner angle for the reception of the eye-lobe; surface convex, irregularly striated by very fine lines, which radiate from the base of the eye-tubercle; marginal rim of moderate width, flattened, the flattening extending upon the spine; occipital furrow well pronounced and reaching to the inner margin of the posterior spine.

Suture-lines distant, cutting the anterior margin of the head with a slightly inward curvature, leaving the frontal limb nearly half as wide as the entire width of the base of the head; thence directed gently inward, with a slight curvature to the anterior angle of the eye, and, after passing around the eye-tubercle is directed in a straight line to the posterior margin of the head, which it reaches at about two-thirds of the distance between the glabella and outer margin of the cheek.

Eye distinct, slightly elevated, distinctly reniform, and about one-third as long as the glabella and occipital ring.

Thorax considerably wider than long, distinctly trilobed, rather rapidly tapering from the third or fourth segment posteriorly, and composed of twelve segments. Axial lobe rather narrow and gradually tapering throughout, scarcely equaling at its widest part one-fourth of the entire width of

the thorax; segments distinct, moderately elevated, slightly flattened, and, on the older specimens, having obscure flattened tubercles at the outer extremities; lateral lobes convex, flattened on the inner half, and gradually rounding on the outer portion, becoming flattened and slightly concave toward the free ends of the pleura. Pleura straight for nearly one-half their length, beyond which they are directed backward with an increasing curvature to the free ends; furrows broad and deep, occupying nearly the entire breadth of the pleura on the straight portion, beyond which they are narrowed, and become obsolete on the flattened part of the extremities.

Pygidium small, elliptical, the anterior and posterior margins nearly equally rounded; outer angles obtuse; surface convex, strongly trilobed; axis not quite one-third of the entire width, prominently convex, and reaching nearly to the posterior margin, marked by three rings exclusive of the terminal ones; lateral lobes depressed-convex, marked by three pairs of furrows, which are curved backward, and become obsolete before reaching the margin.

This species differs from *Conocephalites* (*Conocoryphe*) *Kingii* Meek in its broader form, proportionally wider axis, and smaller pygidium; in having one less thoracic ring, a broader and less conical glabella; and in the broader furrows of the pleura, as well as in several points of minor importance. It also bears considerable resemblance to *Loganellus Loganii* Devine (Pal. Foss. Canada, vol. 1, pp. 200 and 201), but differs conspicuously in the proportionally larger cephalic shield, larger cheek-spines, and in wanting the extended extremities of the pleura, as in that species.

Formation and locality.—In dark-colored limestone of the Potsdam group, on the west side of Pogonip Mountain, and near French Mine, White Pine District, Nevada. Collected by Arnold Hague, esq.

Almondbergia
~~CREPICEPHALUS~~ (*LOGANELLUS*) *NITIDUS* n. sp.

Plate II, figs. 8-10.

Glabella pyramidal, squarely truncate in front; lateral margins nearly straight; height above the occipital furrow less than the width at the base, and the anterior end equal in width to the entire height, including the occipital ring, separated from the fixed cheeks by well-defined, rather deep,

dorsal furrows. Surface regularly convex, with a scarcely perceptible angularity along the median line, which is seen only by the reflection of light from the surface; glabellar furrows nearly obsolete, or the posterior pair visible only on the most critical examination. Occipital furrow narrow, and the ring distinct and rounded.

Fixed cheeks rather narrow, prominent at the eye, and rapidly declining in front, and more especially to the antero-lateral angles of the frontal limb; ocular ridges distinct. Frontal limb, including the narrow, elevated, and rounded border, as long as the width of the anterior end of the glabella, and strongly convex between the rim and glabella, from which point it rapidly descends to the margin; very wide in front between the suture-lines, and rapidly contracting to the eyes. Posterior lateral limbs triangular, their lateral extension greater than the width from the eye to the basal border of the head. Eye-lobes small.

Facial sutures cutting the front margin considerably outside of the line of the eye, the angles of the limb slightly rounded; from this point the line is directed strongly inward to the eye, behind which it again passes outward and downward to the posterior margin, making an angle of about thirty-five degrees with the base of the head. Surface of the crust of the head smooth.

The pygidium associated with the glabellas in the same fragments of rock is suborbicular or obscurely pentangular, slightly transverse; the posterior margin regularly curved; junction of the anterior and posterior lines forming obtuse angles; the anterior margin is also angular on the shoulders. Axis small, convex, about two-thirds the length of the shield, and marked by four annulations exclusive of the terminal ones; lateral lobes flattened, broad, slightly convex on the inner half; anterior margin bordered by a strong flattened rib, extending to the lateral angles; three other obscure ribs mark the convex portion; border broad and flattened.

The species differs from any other herein described in the short, truncate glabella, associated with the laterally-expanded frontal limb, and want of glabellar furrows. There are none of the Wisconsin species which approach it in the combination of these features. *C. Iowensis* is perhaps as closely related as any, but the eyes are much larger, and the lateral limbs very much longer and narrower. The pygidium has much the appearance

of a *Dikellocephalus*; but, as there is no other form of pygidium in the rock containing the heads, it would seem to belong with them.

Formation and locality.—In limestone of the Potsdam group, at Eureka, Nevada. Collected by Arnold Hague, esq.

CREPICEPHALUS (LOGANELLUS) GRANULOSUS n. sp.

Plate II, figs. 2-3.

Glabella and fixed cheeks when united having a quadrangular form, with projecting posterior lateral limbs, giving to the whole a somewhat pyramidal form, with a broadly-truncated summit.

Glabella short-conical, somewhat rapidly tapering in front of the occipital furrow, and squarely truncate at the summit; height equal to the width at the occipital furrow; surface depressed-convex, and marked by three pairs of very oblique furrows, the posterior pair extending nearly across and almost uniting in the middle with the occipital furrow; anterior pair very short and faint, situated near the anterior angles of the glabella; second pair intermediate in size and position.

Fixed cheeks about half as wide as the center of the glabella, very prominent in the region of the eye, and rapidly declining anteriorly and posteriorly from this point; palpebral lobes long and narrow, rather distinct and prominent. Frontal limb nearly half as long as the glabella anterior to the occipital furrow, rapidly declining forward, and bordered by a thickened rounded rim, which is equal to one third of the entire length of the limb; the space between the glabella and the marginal rim is strongly convex. Posterior lateral limbs triangular, once and a half as long as high; ocular ridges existing in the form of an abrupt elevation, passing from the front of the eye to the anterior furrow of the glabella; occipital furrow strongly marked on the lateral limb.

Facial suture passing in a direct line from the eye to the anterior margin, and from behind the eye obliquely backward to the posterior margin of the head, forming an angle of about thirty degrees to the occipital line.

Surface of the crust densely covered by rather coarse granules or pustules.

This species approaches more nearly to *Conocephalites Shumardi* Hall (16th Rept. State Cab., p. 154, pl. 1, fig. 7, and pl. 8, fig. 2) than to any other described species, but differs very conspicuously in the greater breadth of the front of the head between the facial sutures. No other parts of the organism have been detected. Although the fragments of rock containing the heads are filled with Trilobitic remains, there are none showing the granulose surface corresponding to this one; and, where the entire crust of the head is so thickly covered with granules, it would seem natural to suppose the other parts of the animal would be similarly marked.

Formation and locality.—In compact limestone of the Potsdam group at Eureka, Nevada. Collected by J. E. Clayton, esq.

CREPICEPHALUS (LOGANELLUS) MACULOSUS n. sp.

Plate II, figs. 24, 25, and 26?

Glabella and fixed cheeks quadrangular; glabella rounded, conical, a little higher than wide, and highly convex, prominent and gibbous along the median line, marked by very oblique furrows, only two pairs of which show upon the cast, except on critical examination, the anterior pair being very obscure, and situated very near the anterior end of the glabella; middle pair more distinct, and situated at about the anterior third of the length; posterior pair commencing a little behind the middle of the length, at the margin, and directed backward so as to unite with the occipital furrow just before reaching the center of the glabella, separating the posterior glabellar lobes, which form triangular areas of large size; occipital furrow wide, and ring distinct.

Fixed cheeks nearly half as wide as the central diameter of the glabella, moderately prominent in the middle near the eye-lobe, and gently declining in front and posteriorly; ocular ridges strongly marked. Frontal limb longer than the width of the fixed cheeks, strongly convex in front of the glabella, and rapidly declining to the front margin, which has been bordered by a narrow rim, the form and extent of which has not been determined. Lateral limbs unknown. Surface of the cast, except the glabella, which is smooth, marked by distant elevated pustules of moderate size.

A movable cheek, associated in the same blocks, and possessing a simi-

lar surface, is distinctly convex between the eye and the outer border, and the latter rather broad and flattened, separated from the inner convex area by an abrupt sinus, and terminating behind in a short, sharp, rounded spine, and anteriorly the under surface is continued in a spiniform extension. The facial suture starting from the front margin on a line with the eye passes in a nearly direct line to the eye, behind which it passes obliquely with a sigmoid curve to the posterior line of the head, a little outside of the center of the movable cheek, as seen on the latter.

Associated with the above specimens are several forms of pygidia, two of which have the form and character of *Dikellocephalus*, while other two are similar to forms associated with, and referred to heads of this kind in the sandstones of Wisconsin. One of these is transversely elliptical, nearly twice as wide as long, acutely pointed at the lateral angles; the anterior and posterior margins nearly equally curved, the posterior being a little the most regularly arcuate. Axis narrow, and not more than two-thirds the length of the shield, roundly pointed at the extremity, and marked by five annulations, exclusive of the terminal ones; lateral lobes broad and flattened, very slightly convex on the inner half; anterior border marked by a comparatively strong and distinct rib, with two fainter, almost obsolete ribs farther back; margin wide and plain; surface smooth.

This species differs from any other in the collection, and also from all those from the Wisconsin localities, in the general form and pustulose surface. Mr. Billings describes a species under the name of *Bathyrurus conicus*, from the calciferous formation at St. Timothy, on the Beauharnois Canal, Canada, having a similarly-formed glabella and pustulose surface, but showing no furrows on the glabella.

Formation and locality.—In limestone of the Potsdam group, at Eureka, Nevada. Collected by Arnold Hague, esq.

CREPICEPHALUS (LOGANELLUS) UNISULCATUS n. sp.

Plate II, figs. 22-23.

Glabella and fixed cheeks united, elongate-quadrangular in form, the entire length nearly one-third greater than the width between the suture-lines on the anterior margin; sides very gently increasing in width to the base of the posterior limbs.

Glabella moderately tapering from the base anteriorly, and squarely truncate in front, the width of the anterior end equal to half of the entire height; marked by a single pair of transverse furrows near the base, which are united and deepest on the middle of the glabella, the outer extremities having a slightly forward curvature. The second pair of furrows are very faintly marked, and sometimes obsolete or only seen in the reflection of light across the surface, oblique, and situated anterior to the middle of the length of the glabella; anterior furrows obsolete.

Fixed cheeks rather narrow, prominent at the eye-lobes, and rapidly sloping anteriorly and posteriorly; separated from the glabella by very sharp and distinct dorsal furrows. Frontal limb short, abruptly convex between the anterior margin and the glabella, strongly arched upward in the middle, and bordered by a narrow, thickened, rounded rim; ocular ridges not observable; occipital furrows and ring distinct. Lateral limbs not observed.

A pygidium associated in the same block is transversely broad, semi-circular, or short paraboloid; nearly twice as wide as long, and margined on the under side of the posterior border by a wide, considerably thickened, recurved selvage. Axial lobe narrow, depressed-convex, and marked by six annulations exclusive of the terminal ones; lateral lobes depressed-convex; their anterior margin bordered by an elevated ridge, which extends with increasing strength to near the outer angle; two other faint ribs can be detected on each lobe.

The species somewhat closely resembles *Conocephalites Shumardi* Hall (16th Rept. State Cab., p. 154, pl. 7, figs. 1 and 2, and pl. 8, fig. 32). It is, however, proportionally wider in front between the suture-lines, the palpebral lobes are smaller, and the furrows of the glabella less distinct. The pygidium is also very similar, but proportionally longer, the axis stronger, and the ribs of the lateral lobes much more distinct.

Formation and locality.—In limestone of the Potsdam group, at Eureka, Nevada. Collected by J. E. Clayton, esq.

Head within the facial sutures quadrangular in form, exclusive of the postero-lateral limbs, slightly contracted in width in the region of the eyes.

Glabella narrowly conical, very gradually tapering from the base anteriorly, the sides nearly straight, and rather squarely truncate in front; bordered by distinct, impressed, dorsal furrows; surface evenly convex throughout, and marked by three pairs of faint, moderately oblique, transverse furrows; the two anterior pairs not extending quite one-third of the width of the glabella; third or posterior pair longer, but faintly marked, their inner ends strongly recurved, almost separating the posterior glabellar lobes; occipital furrow distinct; ring prominent and rounded.

Fixed cheeks of moderate width, prominent at the eye-lobes, and rapidly declining in front and behind; ocular ridges faintly marked. Frontal limb longer than the width of the fixed cheeks, bordered by a narrow, elevated rim, between which and the front of the glabella it is distinctly convex, and the part immediately in front of the glabella more strongly convex. Eye-lobes small. Posterior lateral limbs not known. Surface of crust smooth.

Specimens of movable cheeks associated with the above, and corresponding in character, are somewhat triangular in form; margined by a slightly-flattened, elevated border of moderate width, which is continued in a long, rather slender spine at the posterior angle; inner area of the cheek convex and distinctly marked with radiating striæ; inner angle strongly notched for the proportionally large eye-lobe. Pygidium unknown.

The species very closely resembles in form and characters the corresponding parts of *C. (L.) maculosus*, but is somewhat shorter in proportion to the width; the glabella is not rounded at the summit as in that species, and the furrows are more distinctly marked and not so oblique, while the surface does not possess the pustules characteristic of that one.

Formation and locality.—In limestone of the Potsdam group, at Eureka, Nevada. Collected by Arnold Hague, esq.

CREPICEPHALUS (LOGANELLUS) *ANYTUS* n. sp.

Plate II, figs. 19-21.

Glabella and fixed cheeks, when united, irregularly quadrangular in form, contracted at the eyes, and broadly spreading below by the projecting postero-lateral limbs.

Glabella conical, moderately tapering anteriorly; the height and width about equal, measuring from the occipital furrow, and the width of the anterior end equaling two-thirds of the height; marked by three pairs of transverse furrows, the posterior and middle ones distinct and strongly recurved, situated at the first and second third of the length of the glabella; anterior furrows small and faintly marked, rising from the antero-lateral angles of the glabella and directed obliquely backward; occipital furrows broad and well defined; ring distinct and moderately elevated.

Fixed cheeks about half as wide at the eyes as the width of the anterior end of the glabella, widening in front and rapidly expanding behind, moderately elevated but not prominent; ocular ridges very strong, prominent, and rounded; frontal limb as long as the width of the front of the glabella, and rather rapidly sloping from the glabella to the anterior marginal rim, which is of moderate width, and rounded in the smaller specimens, but becomes thin and somewhat projecting and angular in the center in older individuals. A distinct angularity along the median line of the entire head is a noticeable feature. Postero-lateral limbs triangular, their length from the dorsal furrows about once and a half as great as their breadth at base, the lower edge distinctly grooved by the occipital furrows. Facial sutures distant on the anterior margin of the head, and rapidly converging to the eye, behind which they are directed obliquely backward to the posterior border of the head, at an angle of about thirty-five degrees to the occipital border, forming a slightly sigmoidal line.

Movable cheeks irregularly triangular, elongated in a postero-lateral direction, and produced behind in form of a sharp, rather slender spine, one-half as long as the cheek; central area convex, and strongly marked with radiating striæ; border wide and flattened, or slightly rounded; ocular sinus small.

Pygidium transversely elliptical, obtusely angular at the lateral extrem-

ities; anterior and posterior margins subequal; the anterior margin having the flattest curve. Axis narrow, two-thirds as long as the shield, and marked by three annulations exclusive of the terminal ones; lateral lobes large, concavo-convex, the margin being slightly recurved; border thin and entire; four faintly-marked ribs may be counted on each side.

This species closely resembles *C. (L.) simulator* in the form of the middle portions of the head, but is proportionally longer in front of the eye, and this latter organ smaller than would be indicated by the sinus in the cheek referred to that species, while the cheeks are more oblique and longer in a postero-lateral direction. The parts here associated are the only ones occurring in the specimens from the locality, and there can therefore be no doubt of their correct reference to the one species.

Formation and locality.—In limestone of the Potsdam group, at Schell Creek, Nevada. Collected by J. E. Clayton, esq.

CREPICEPHALUS (BATHYURUS ?) ANGULATUS n. sp.

Plate II, fig. 28.

Entire form unknown, the specimen consisting only of an imperfect glabella and fixed cheeks united. The form of the fragment is somewhat quadrangular, strongly angular in front, and constricted at the anterior angle of the eye-lobe.

Glabella rounded-conical, narrowly rounded at the summit, strongly and regularly convex on the surface, the height and width subequal, measured from the occipital furrow, entirely destitute of transverse furrows; occipital ring narrow, moderately prominent, and having the appearance of an obscure tubercle in the center. This feature may be deceptive.

Fixed cheeks narrow at the eyes; palpebral lobes small, obliquely situated; postero-lateral limbs short, equilaterally triangular; continuation of the occipital furrow faintly marked; frontal limb short in front of the glabella, wide and extended at the sides and antero-lateral angles; the width between the facial sutures equaling the entire length of the head; anterior margin thickened, distinctly angular in the middle, the sides sloping rapidly to the suture-lines. Facial suture cutting the anterior margin a little outside of a line with the outer angle of the eye, and directed with a gently convex

curvature to the anterior angle of the ocular sinus; behind the eye, it is directed obliquely outward to the posterior margin of the head at an angle of about forty-five degrees. No indication of ocular ridges can be detected.

There is considerable doubt as to what genus this species should be referred. It lacks many of the characters of *Crepicephalus* and *Conocephalites*, and possesses neither glabellar furrows nor ocular ridges. The form of the glabella corresponds with many of those referred to the genus *Bathyrurus* by its author, but it differs in the direction of the facial sutures; in this latter feature, it corresponds with *Loganellus* Devine, but differs in the absence of glabellar furrows. The projecting angular frontal margin is a marked and distinguishing feature.

Formation and locality.—In the lowest beds of limestone, Potsdam group, on the west side of Pogonip Mountain, White Pine, Nevada; associated with *Pterocephalus laticeps*. Collected by Arnold Hague, esq.

Genus PTEROCEPHALUS Roemer.

CONOCEPHALITES (PTEROCEPHALUS) LATICEPS n. sp.

Plate II, figs. 4-7.

Entire form unknown; the remains consisting of dismembered and fragmentary parts imbedded in the rock together.

Glabella and fixed cheeks, when united, having a somewhat elongate-quadrangular form, exclusive of the postero-lateral limbs; widest at the front margin, and contracted in the region of the eyes; the greatest width being one-fifth less than the entire length of the head. Glabella comparatively small, highly convex and subangular along the median line, regularly tapering from the base, including the occipital ring, to the summit, which is rather abruptly truncate; width at the occipital lobe more than equaling three-fourths of the entire height, and the width across the anterior lobe of the glabella equal to a little more than one-third of the height. The glabella is divided by three pairs of strongly-marked transverse furrows, which extend about one-third of the width of the glabella at their respective points, and are slightly inclined backward at their inner ends, separating the glabella into four pairs of distinct lobes, which decrease regularly in

size from below upward. Occipital furrow narrow, not extending entirely across the lobe; occipital ring narrow, flattened on the outer ends, and marked by a node-like tubercle in the center.

Fixed cheeks broad in proportion to the size of the glabella; palpebral lobes large, rapidly rising from the margin of the glabella to the border of the eye; lateral limbs of moderate size, and, judging from the direction of the sutural margin of the movable cheek, have been short, and rapidly sloping, with an almost direct line, from the posterior angle of the eye to the posterior border of the head. Frontal limb excessively expanded, and forming about three-fifths of the entire length of the head, including the occipital ring. From the front of the glabella, the surface rises gently for a distance equal to the width of the anterior end of the glabella, and beyond is gracefully and gently concave to the anterior margin, where it has been bordered by a double rim. The rising surface in front of the glabella is distinctly marked by fine, irregular lines, or striæ, radiating from the edge of the glabella. Ocular ridges well pronounced, rising from the sides of the anterior lobe of the glabella, and passing with a slight upward curvature to the anterior angle of the eye-lobes. Eyes not observed.

Movable cheeks very large and wide, irregularly triangular in outline, the posterior angle projecting backward in the form of a broad, short, flattened spine; outer margin gently arcuate; anterior margin, forming the facial suture, slightly concave to near the eye, where it becomes slightly recurved. Ocular sinus large. Surface of the cheek gently concave from the eye to the outer border, and marked by a low, rounded ridge parallel to the margin at a little more than one-third of the entire width from the eye. Continuation of the occipital furrow very faintly marked. Upper surface of the cheek marked by fine, closely-arranged, irregular striæ, nearly parallel with the margin. Under surface more strongly and distantly striated.

Thorax known only by a part of a single articulation, associated with the other parts in the same fragment of rock. The fragment consists of a right pleura, and is of moderate width, with parallel margins slightly recurved throughout its length, and more abruptly near the free extremity. The surface is characterized by a very broad, shallow furrow, occupying nearly the entire width, and becoming obsolete near the end of the rib. The ante-

rior margin is elevated, forming a narrow, sharply-rounded ridge, gradually widening toward the outer end. The upper surface bears no markings whatever, while the under side is marked by strong obliquely vertical striæ.

The pygidium associated with the other parts is transversely elliptical, almost one-third wider than long; the anterior and posterior margins nearly equally rounded, and the lateral extremities; or sides, somewhat subangular at the junction of the two lines; the posterior margin deeply and angularly notched in the middle. Axial lobe small, about one-half as long as the shield, elevated and subangular along the median line, and obscurely pointed behind; marked by seven low, rounded rings, exclusive of the terminal ones. Lateral lobes large, concavo-convex, rather rapidly declining on the inner half, and slightly recurving to the margin; marked by five broad, rather indistinct ribs, exclusive of the anterior articulating projection, which become obsolete near the middle of the lobe.

The species is peculiar in its broad, expanded cephalic shield and rapidly-tapering conical glabella; in these respects differing from all other forms with which it is associated, as well as all of those from the Wisconsin beds of this age, to so great an extent that there is not the least danger of mistaking it. In the broadly-expanded cheek and frontal limb, it resembles some forms of *Dikellocephalus*, as well as in the form of the pygidium; but the glabella is so very different that it at once distinguishes it, although so closely allied to that genus in other respects.

It closely resembles *Pterocephalus Sancti-sabæ* Roemer, from the same position in Texas (see Kreid. von Texas, plate xi, fig. 1, p. 93), but differs specifically in many and important features.

Formation and locality.—In the lowest limestones seen on the west side of Pogonip Mountain, White Pine, Nevada; age of the Potsdam group. Collected by Arnold Hague, esq.

Genus PTYCHASPIS Hall.

E. formia
PTYCHASPIS PUSULOSA n. sp.

Plate II, fig. 27.

Entire form unknown. Glabella and fixed cheeks united, irregularly quadrangular in form, slightly angular in front, the margin declining on

each side of the middle. Glabella strongly convex, subangular along the central line; broadly conical in outline, and rounded-truncate in front; the length from the occipital furrow a very little exceeding the greatest width at base; marked by two pairs of transverse furrows, which divide it into three nearly equal parts on the margin, and are directed very obliquely backward for their entire length, reaching two-thirds of the distance between the margin and the median line. Occipital furrows broad, well defined; occipital ring rather strong.

Fixed cheek wide, separated from the glabella by an indistinctly defined furrow; ocular ridge strong, rising from the upper lateral angles of the glabella, and passing with but little curvature to the anterior angle of the eye. Front border of the head of moderate width; marginal rim thickened and cord-like, separated from the inner portion by a deeply-marked furrow, within which the surface rises abruptly to the edge of the narrow anterior furrow bordering the glabella. Posterior lateral limbs unknown.

Surface of the fixed cheeks and frontal limb marked with strong, scattered granules or pustules. The surface of the glabella may have been marked with similar pustules, but has been somewhat injured by weathering, so that none show in its present condition.

The species somewhat closely resembles *Ptychaspis Miniscaensis* Owen's sp., from the Mississippi Valley, in the form of the glabella and the furrows marking the same, but differs in the wider fixed cheeks and the form of the anterior border, so far as that one is known, as well as in the pustulose surface. No other parts of the organism have been detected than those here described.

Formation and locality.—In the lowest layers of limestone seen, on the west side of Pogonip Mountain, White Pine District, Nevada; of the age of the Potsdam sandstone. Collected by Arnold Hague, esq.

Genus CHARIOCEPHALUS Hall.

CHARIOCEPHALUS TUMIFRONS n. sp.

Plate II, figs. 38-39.

Glabella large, prominent, and cylindrical, nearly as wide as long, strongly rounded and protuberant in front, projecting beyond the rim of the

head fully one-fourth of its entire length, including the occipital ring, in a rounded, tumid boss; marked by two transverse furrows anterior to the occipital ring, the anterior one rudimentary and directed forward, visible only on the sides of the glabella; posterior furrows strong and deep, but narrow, extending entirely across the glabella in equal strength and nearly in a direct line, situated a little in front of the middle of the entire length of the head; occipital furrow a little stronger than the posterior glabellar furrow, directed slightly forward in the middle. Occipital ring wide and flattened, about of the same dimensions as the space between the occipital furrow and the posterior glabellar furrow.

Fixed cheeks trapezoidal, strong, and broad, inflated and tumid between the eye and the glabella, so as to overhang the eye and the suture-line. Frontal limb very short, and abruptly bent downward. Posterior lateral limbs short-triangular, nearly vertical outside of the line of the eye; occipital furrow deep, and the ring narrow; ocular sinus very small, situated on a line with the occipital furrow of the glabella.

Facial suture cutting the anterior margin of the head a little outside of the line of the glabella, and almost immediately deflected outward with a strong convex curvature to the ocular sinus, behind which it is directed to the posterior border at an angle of about forty-five degrees to the axis.

Surface of the crust smooth, so far as can be determined from the specimens.

The species will be easily recognized by the highly convex and cylindrical glabella, which projects far in advance of the frontal border of the head.

Formation and locality.—In the lowest limestone beds on the west side of Pogonip Mountain, White Pine District, Nevada, of the age of the Potsdam group; associated with *Conocephalites* (*Dikellocephalus*) *laticeps*, *Bathyrurus*? *angulatus*, &c. Collected by Arnold Hague, esq.

Genus DIKELLOCEPHALUS Owen.

Associated with the preceding species from the Eureka beds of the Potsdam group are two forms of pygidia, so unlike anything positively known to belong to species with conical or slipper-shaped glabellas, that it

seems unnatural to thus refer them. On the other hand, they so closely resemble the corresponding parts of the genus *Dikellocephalus* from the sandstone of the Mississippi Valley, that it has been deemed safer to refer them to that genus, although no other parts recognized as belonging to the genus have been observed. It is even more than probable, however, that, on examining a larger collection of material from this locality, other parts of the organisms will be found justifying this reference, as there are many fragmentary portions of undetermined species in the few blocks now before us.

DIKELLOCEPHALUS BILOBATUS n. sp.

Plate II, fig. 36.

Pygidium transverse, irregularly oval, rather straight on the anterior border, rounded and deeply bilobed on the posterior margin by a sharply angular constriction of the posterior border on the median line, extending to the extremity of the axial lobe; marginal lobes rounded on their posterior extremities. Axis comparatively small, moderately convex, marked by six or seven transverse rings, exclusive of the terminal ones. Lateral lobes broad, rounded behind, and wing-like, slightly convex on the under surface, and recurved toward the border; marked by four ribs on each side, which appear to have been obscurely divided, and do not extend to the margin of the shield. On the under surface, the posterior border is inflected, forming a very wide inner rim, or lining, occupying nearly one-half the area of the lateral lobes. Surface apparently smooth.

The deeply bilobed character of the posterior border is a marked and distinguishing feature.

Formation and locality.—In limestone of the Potsdam group, in the Eureka District, Nevada. Collected by Arnold Hague, esq.

DIKELLOCEPHALUS MULTICINCTUS n. sp.

Plate II, fig. 37.

Pygidium somewhat triangular in general form, or, considering the anterior border as consisting of two sides, would be somewhat trapezoidal; front margin arcuate, a little angular on the shoulders, and more rapidly declining toward the outer extremities; the entire front nearly semicircular; posterior margin extended in the direction of the median line, and presenting the appearance of having been digitate on the lateral borders. This

feature may have been wrongly interpreted, as the specimen is mutilated and somewhat obscure. Axial lobe narrow and moderately elevated; less than two-thirds of the entire length of the shield; marked by ten very short annulations, exclusive of the terminal ones. Lateral lobes moderately convex in the middle and becoming flattened toward the margin; marked by five simple, faint ribs on each side, exclusive of the anterior one, which is also the most prominent and angular. The posterior border has the appearance of having been produced at the extremity into a broad, flattened, triangular process, or spine; and judging from another individual, apparently of the same species, has had two other points or digitations on each side, one at the lateral angle and the other just below, leaving a deep, broad sinus between it and the central point.

The specimen has some resemblance to small convex examples of *D. Minnesotensis* Owen, but differs in the more arcuate anterior border, extended posterior extremity, and greater number of rings on the axis. From *D. Pepinensis* Owen, it differs in the stronger axis, more numerous rings, simple ribs of the lateral lobes, and in the form of the posterior lateral margins.

Formation and locality.—In limestone of the Potsdam group, in the Eureka District, Nevada. Collected by Arnold Hague, esq.

DIKELLOCEPHALUS FLABELLIFER n. sp.

Plate II, figs. 29-30.

A small pygidium occurring in a fragment of dark-colored limestone, associated with those containing *Conocephalites laticeps*, *Bathyurus ? angulatus*, and *Chariocephalus tumifrons*, but probably from a different layer, judging from the lithological characters of the specimens, has a character so marked and peculiar that it has been deemed worthy of notice. The specimen possesses the following characters:

Pygidium transversely semicircular, the length and width being as three to seven; front margin slightly arcuate to near the outer extremities, where it curves somewhat abruptly backward to the point of the first digitation. Posterior margin digitate, having three points on each side, and a central one; digitations broad and obtuse, the middle one on each side the largest. Axial lobe of moderate strength, highly convex, faintly subangular

along the median line, reaching two-thirds of the entire length of the shield; obtusely pointed at the extremity, and marked by five transverse rings, exclusive of the terminal ones, which gradually decrease in size posteriorly. Lateral lobes moderately elevated and convex on the inner half, becoming concave or flattened toward the edge; marked by four elevated, angular ribs on each side, including the one submarginal to the anterior border, with broad, shallow, depressed areas between them. The ribs rise from the margin of the axial lobe, and reach the border of the shield at the angles of the marginal sinuosities, most strongly marked near the axis, and becoming nearly obsolete toward the outer border. Surface of the crust apparently smooth.

The specimen is remarkable for the simple ribs of the lateral lobes, and for the digitation of the margin. In these respects, it differs very materially from any Trilobite hitherto described from the Potsdam group; and it is possible that it may have come from a somewhat higher position at the same locality than the other specimens with which it is placed.

Formation and locality.—In dark crystalline limestone of the Potsdam group, on the west side of Pogonip Mountain, White Pine District, and in the Eureka District, Nevada. Collected by Arnold Hague, esq.

Genus AGNOSTUS Brongniart.

AGNOSTUS COMMUNIS n. sp.

Plate I, figs. 28-29.

Cephalic shield subparaboloid, wider than long, the respective diameters being as six and seven. Surface strongly convex and distinctly trilobed. Glabella nearly equaling one-third of the width of the shield, more prominent than the lateral lobes, and separated from them by distinct dorsal furrows, three-fourths as long as the entire length of the head, broadest at base and gradually narrowing for two-thirds of the length, beyond which point it is more abruptly narrowed or obtusely pointed; anterior third separated from the part behind by a faint, scarcely perceptibly impressed, transverse line. Central portion of the glabella marked by a distinct elongated and angular tubercle. Right and left lateral lobes, or sides of the head, separated in front of the glabella by a narrow furrow, which is a continuation

of the dorsal furrows, and reaches to the anterior border. Small triangular occipital nodes are situated one on each side at the base of the glabella. Entire shield margined by a flattened border of moderate width. Thoracic segments unknown.

The caudal shield associated with the above in the same fragments of rock, and in equal numbers, is shorter in proportion to its width, being more regularly rounded, and is margined by a similar flattened border, which is projected in form of a short, spine-like process on each side, about two-thirds of the length from the anterior border. Surface strongly convex and trilobate in the anterior half, the dorsal furrows being directed gently inward for half their length, and then suddenly deflected outward with a slight curvature, becoming obsolete a little behind the middle of the length. An elongated, angular node marks the axial lobe near its anterior margin. Surface of both shields smooth under an ordinary magnifying power. Length of the larger specimens about one-seventh of an inch.

Formation and locality.—In blackish limestone of the Potsdam group, White Pine. Collected by A. J. Brown, esq.

AGNOSTUS NEON n. sp.

Plate I, figs. 26-27.

Cephalic shield short, subparaboloid, three-fourths as long as wide, highly convex; sides nearly straight for half its length from the base, and gradually rounding in front; anterior margin broadly rounded, being almost straight in the middle. Glabella rather more than two-thirds the length of the shield, and less than one-third as wide at its base, conical throughout, more rapidly tapering near the anterior end; anterior third distinctly separated by a transverse furrow. Dorsal furrows well marked, scarcely continued in front of the glabella; occipital nodes large, rounded-triangular. Lateral lobes of the head convex, margined in front and on the sides to just behind the middle of the length by a narrow, flattened border, which gradually becomes obsolete before reaching the posterior line of the head. Thoracic segments unknown.

Caudal shield of similar form to the cephalic shield, but entirely margined by a flattened border of nearly twice the width of that of the head,

and much wider posteriorly than on the sides, produced into spine-like projections at the lateral angles. Axial lobe distinct, strongly marked, more than one-third as wide as the entire shield; posterior division, or lobe, broader, rounded; anterior division short; annulation well marked; a longitudinally angular node marks the middle of the axis, extending from the anterior to the posterior division, across the furrow which marks their limits.

This species differs from the *A. communis* in the shorter form of the cephalic shield, and proportionally longer caudal shield, both being equal in this species, while in that one the cephalic shield is much the longest. It also differs in the wider border of the caudal shield and in the absence of a node on the glabella. The caudal shield is precisely similar to that of *A. Josepha* of the Wisconsin sandstone of similar age, except in the spine-like processes of the lateral angles. The cephalic shield, however, is entirely different.

Formation and locality.—In limestone of the Potsdam group, at Eureka, Nevada. Collected by Arnold Hague, esq.

AGNOSTUS PROLONGUS n. sp.

Plate I, figs. 30-31.

Cephalic shield elongate, or very high dome-shaped in outline; sides straight, or nearly straight, for more than one-half the length, above which the margin, including the anterior border, is regularly and beautifully rounded. Surface low or depressed-convex in front and gradually rising to near the occipital border, where it becomes low-tumid; glabella not visible except under a strong magnifying power, and by the reflection of light across the surface, when the outline of a conical form, with triangular occipital nodes, may with difficulty be detected. The shield is margined by a narrow, somewhat rounded rim, which gradually fades out toward the postero-lateral angles. Thoracic segments unknown.

The caudal shield associated with the head is much shorter in proportion to the width. The form is much like that of a cephalic shield, and it is with some hesitation that we have associated it with the above. Its shortness, however, and the want of occipital nodes, together with the

absence of all other forms in the same block, has determined us in so doing. The axial lobe forms more than one-third the width of the shield, is short and rounded obconical; marked by a node at its upper end, and divided across by a doubly-curved transverse furrow near the lower end. Dorsal furrows distinct, and continued as a median furrow from the end of the axial lobe to the posterior margin. Posterior border emarginate and surrounded by a flattened rim.

Formation and locality.—In limestones of the Potsdam group, at Eureka, Nevada. Collected by Arnold Hague, esq.

AGNOSTUS TUMIDOSUS n. sp.

Plate I, fig. 32.

Cephalic shield highly dome-shaped in outline, very slightly contracted near the occipital border, very convex, and margined by a narrow, flattened border. Dorsal furrows very distinct, not continued in front beyond the glabella. Glabella proportionally small, less than two-thirds as long as the head, distinctly conical in form and very highly convex, especially tumid in the lower part; the central tubercle marked near its edge by a very slight, depressed line, which presents the appearance of a border surrounding it. Anterior lobe forming a little more than one-fourth of the length of the glabella; the furrow separating it from the principal lobe very distinct. Occipital nodes very small, triangular, and distinctly modifying the base of the glabella on each side. Thoracic segments and caudal shield unknown.

The specimen above described is so entirely distinct and well marked that we have no hesitation in giving it as a species, although it is as yet the only individual specimen noticed. The highly dome-shaped outline, literally horseshoe-shaped, is peculiar, which, together with the form and markings of the glabella, cannot fail to distinguish it from all others.

Formation and locality.—In limestones of the Potsdam group, at Eureka, Nevada. Collected by Arnold Hague, esq.

FOSSILS OF THE LOWER SILURIAN.

BRACHIOPODA.

Genus LINGULEPIS Hall.

LINGULEPIS ELLA n. sp.

Plate I, fig. 8.

Shell below the medium size. Dorsal valve subcircular or oblate, the width slightly exceeding the length; the beak perceptibly projecting beyond the general contour of the shell, but very obtuse and slightly truncate; sides and base rounded, the latter more broadly curved. Surface of the valve depressed-convex, a little the most prominent on the umbone; marked by fine irregular concentric lines of growth on the upper part, becoming more strongly marked and finally quite lamellose toward the margin of the valve. A few very indistinct, radiating lines may be seen near the beak by the aid of a strong magnifier. Ventral valve unknown. Shell-substance phosphatic.

There may be some doubt as to the true relations of this shell. The broadly oblate form would be an objection to considering it as a true *Lingula*, while the truncation of the beak of the dorsal valve would accord more nearly with what is known of some forms of *Lingulepis*. It is possible it may prove to be a *Lingulella*, but, in the absence of the ventral valve, it cannot be satisfactorily determined. It differs from most known species very perceptibly in the oblate form of the valve.

Formation and locality.—In greenish argillaceous shales of the age of the Quebec group, in the cañon above Call's Fort, north of Box Elder Cañon, Wahsatch Range, Utah. Collected by S. F. Emmons, esq.

Genus ORTHIS Dalman.

ORTHIS POGONIPENSIS n. sp.

Plate I, figs. 9-10.

Shell quite small, seldom exceeding a third of an inch in width, and usually much less; paraboloid in form below the hinge-line, but somewhat

variable in proportion; beak obtuse, and rather prominent; the cardinal margins sloping rapidly to the extremities of the hinge. Area not observed, but, judging from the prominent beak, it must be rather high and but slightly arcuate; hinge-extremities angular, or slightly rounded. Surface of the valves strongly convex and marked by extremely fine striæ, which become a little coarser toward the margins of the shell. Interior unknown.

The species has much the general form of *O. costalis* Hall of the New York Chazy limestone, but the striæ differ greatly in their extreme fineness. It also somewhat resembles *O. Electra* Billings (Pal. Foss. Canada, vol. 1, p. 79, fig. 72), but is not so broad, and the valves are more convex, and beak more prominent. The shells occur in a coarsely granular and highly crystalline limestone, and become more or less exfoliated in separating from the matrix, so that the external features are not perfectly recognized. The examples used are all separated valves, partially imbedded in the rock, so that the hinge-features are not fully revealed. Those figured would seem to be dorsal and ventral, and, if so, the dorsal is much less convex than the ventral.

Formation and locality.—In limestone of the age of the Chazy of New York, Pogonip Mountain, White Pine District, Nevada. Collected by A. J. Brown, esq.

Genus STROPHOMENA Rafinesque.

STROPHOMENA NEMEA n. sp.

Plate I, fig. 15.

Among the specimens received from the gray granular limestones of the Pogonip Mountain, there is a small Strophomenoid shell, which is somewhat semi-oval in outline, about two-thirds as high as wide; the hinge-line nearly straight and not quite as long as the width of the shell below; the cardinal angles are slightly rounded; and the lateral margins and basal line almost regularly curved, forming a little more than half of a circle. The surface of the ventral (?) valve is regularly and evenly convex longitudinally and laterally, but not highly rounded, and marked by rather fine, even, and somewhat sharp radiating striæ. The dorsal valve and interior of the shell have not been seen.

The species presents much the appearance of a *Chonetes* in its regularly rounded valve, even striæ, and general characters, but shows no appearance of spines on the hinge-line. We know of no species of this or any allied genus from rocks of a similar age having a very close resemblance to this one.

Formation and locality.—In the granular limestones of the age of the Quebec group, Pogonip Mountain, west side, White Pine District. Collected by A. J. Brown, esq.

Genus PORAMBONITES Pander.

PORAMBONITES OBSCURUS n. sp.

Plate I, fig. 16.

Shell of moderate size; irregularly transversely oval in form; a little angular toward the beak, and broadly emarginate in front. Ventral valve flattened-convex on the middle of the shell; more sharply rounded near the lateral margins, and strongly bent upward in front in the form of a broad linguiform extension, which is rounded on the end, two-thirds as long as wide, and distinctly concave on the exterior, forming an emargination in the front of the valve; beak very obtuse, short, and but little curved. Dorsal valve unknown, but, judging from the elevation of the front extension of the ventral valve, it must have been quite rotund.

The surface of the shell is mostly exfoliated; but near the front a portion is partially preserved, and shows what appears to have been punctate lines, or striæ, though they are obscure and unsatisfactory. A number of concentric lines of growth are clearly distinguishable. The beak of the specimen, where the shell has been removed, shows the two diverging lamellæ which characterize the genus *Porambonites*. The specimen is quite imperfect, but interesting as representing a genus so seldom recognized in this country.

Formation and locality.—In dark grayish crystalline limestone of the age of the Quebec group, Pogonip Mountain. Collected by A. J. Brown, esq.

GASTEROPODA.

Genus RAPHISTOMA Hall.

RHAPHISTOMA ACUTA n. sp.

Plate I, figs. 20-22.

Shell small to medium size, lenticular in form, and sharply acute on the periphery; volutions three to three and a half, moderately increasing in size with the growth of the shell; suture close. Upper surface of the volutions less convex than the lower, very slightly rounded below the suture-line, and a little concave just within the margin, giving an acutely angular edge. Lower surface of the volution once and a half as deep as the upper part, measuring from the angle; subangular or sharply rounded at the edge of the umbilicus, which is nearly one-third as wide as the entire diameter of the shell, showing all of the inner whorls when free from rock. Aperture triangular, wider than high, acute on the outer edge, the widest part being above the middle. Surface of the shell not observed, the specimens being either internal casts or having partially-exfoliated surfaces.

The species bears considerable resemblance to *R. lenticularis* Sow. from the Trenton limestone, but is more depressed, and the volutions are more angular on the lower side. In this latter feature, it corresponds more nearly with the forms of the genus occurring in the Chazy and Calceiferous formations than with those from the Trenton group, and bears a striking resemblance to some forms of *R. staminea* Hall, but has probably not had the strong surface-markings of that species. It differs from *Euomphalus* ? *rotuliformis* and *E.* ? *trochiscus* Meek in having a smaller number and more rapidly-increasing volutions.

Formation and locality.—In limestone of Lower Silurian age, probably Chazy, at Ute Peak, Wahsatch Range, Utah. Collected by Arnold Hague, esq.

Genus MACLUREA Lesueur.

MACLUREA MINIMA n. sp.

Plate I, figs. 17-19.

Shell quite small, subdiscoidal, the largest individuals not measuring more than four-tenths of an inch in their greatest diameter. Spire depressed,

as in the typical species of the genus, and appearing as an umbilicus on a sinistral shell, the depression rather narrow and abrupt; under side flattened, without any depression or umbilicus. Volutions about two in number, somewhat rapidly increasing in size with the increased growth of the shell; flattened on the lower surface for more than one-half their diameter, but very evenly and regularly rounded above; periphery rounded, a little less so below than above the middle; aperture semi-ovate, or having the form of a circle, with the lower third truncated. Surface of the shell not observed.

The specimens of this species which have been observed are all internal casts, and occur in a coarsely crystalline and quite friable limestone. The substance of the shell has been quite thick, and, being also coarsely crystalline, crumbles at once on attempting to remove the specimens from the surrounding rock, so that the surface-characters of the shell cannot be obtained. The generic features of the specimens are so obvious that there can be no doubt whatever of their right reference to *Maclurea*; and their small size, together with the rounded upper surface of the volutions, which do not show the least tendency to become angular at the edge of the spiral depression or cavity, but is evenly and regularly rounded on the inner as well as on the outer side, will serve, we think, to distinguish it from all other described species of the genus.

Formation and locality.—In limestone, probably of the age of the Chazy limestone of New York, at Ute Peak, Wahsatch Range, Utah. Collected by Arnold Hague.

Genus FUSISPIRA Hall.

FUSISPIRA COMPACTA n. sp.

Plate I, fig. 25.

Shell elongate, turreted; spire elevated, forming considerably more than half, probably two-thirds, of the entire length of the shell; composed of six or more short, compact, rather rapidly-increasing volutions, which are strongly rounded on the surface, and less than half as high as their diameter. Aperture not definitely determined, but apparently elongated, and probably attenuate below, judging from what can be seen of the lower

part of the last volution on the specimen examined. No surface-markings can be detected.

The specimen is quite imperfect, and is only given on account of its low geological horizon; the most of the species hitherto recognized being from the Trenton or Hudson River groups. The species differs from all others of the genus yet described in the short compact volutions.

Formation and locality.—In the granular limestones, Pogonip Mountain, west side, White Pine District, Nevada; of the age of the Quebec group. Collected by A. J. Brown, esq.

Genus CYRTOLITES Conrad.

CYRTOLITES SINUATUS n. sp.

Plate I, figs. 23-24.

Shell small, laterally compressed; composed of about one and a half to two volutions, which are closely coiled, but not embracing. Volutions acutely triangular; the dorso-ventral diameter about one-half greater than the lateral diameter; sides of the outer one marked by a broad, shallow depression or sinus a little within the margin, between which and the umbilicus the surface is rounded. Umbilicus broad, exposing the inner volutions; the sides abrupt or nearly vertical except on the edge, which is slightly rounded. Surface of the shell unknown.

The species is characterized by the vertical margins of the umbilicus, and the broad, shallow, depressed sinus of the outer half of the volution, giving a somewhat concavo-convex curvature to the surface between the umbilicus and the outer edge, or keel. In this respect, it differs from all other species with which we are acquainted.

Formation and locality.—In the granular limestone, on the west side of Pogonip Mountain, White Pine District, Nevada. Collected by A. J. Brown, esq.

CRUSTACEA.

Genus CONOCEPHALITES Zenker.

CONOCEPHALITES SUBCORONATUS n. sp.

Plate II, fig. I.

Glabella short, conical, with straight lateral margins, regularly con-

verging from the base upward to the rather squarely truncated summit; height above the occipital furrow scarcely exceeding the breadth of the base, and the width at the summit equal to about two-thirds of the height; marked by three pairs of very oblique, subequally distant, and moderately distinct transverse furrows. Occipital furrow narrow and well marked; ring distinct, widest and somewhat pointed on the center of the posterior margin.

Fixed cheeks wide, separated from the glabella by distinct dorsal furrows, prominent and rounded between the glabella and eye-lobe, almost equaling the convexity of the glabella; ocular ridges slender and curved. Frontal limb wide and concave, destitute of a thickened marginal rim, as long as the glabella, and obscurely trilobed from an extension of the dorsal furrows, forming a convex, boss-like area in front of the glabella, which is divided transversely by a double depressed line, or narrow fillet, midway of the limb and parallel with the anterior margin of the head. Eye-lobes about half as long as the glabella, obliquely situated, and separated from the fixed cheek by a deeply-depressed ocular sinus.

Facial suture cutting the anterior border on a line with the front angle of the eye, which it reaches by a broad, convex curvature, giving rounded lateral margins to the frontal limb; posterior to the eye, it is directed outward; the actual course not determined. Posterior lateral limbs not seen. Surface of the crust in front of the glabella strongly striated.

The species is only known by the glabella and fixed cheeks. The specimens are all minute, but readily recognized by the peculiar formed boss in front of the glabella.

Formation and locality.—In limestone of the age of the Quebec group, at the base of Ute Peak, Wahsatch Range, Utah. Collected by Arnold Hague, esq.

Genus CREPICEPHALUS Owen? = LOGANELLUS Devine.

CREPICEPHALUS? (LOGANELLUS) QUADRANS n. sp.

Plate II, figs. 11-13.

Form of entire body unknown. Glabella and fixed cheeks together broadly quadrangular, about four-fifths as high as wide, and quite uniform

in many individuals, very depressed-convex, or quite flattened, as occurring on the surface of the shale in which they are imbedded; glabella distinctly conical, moderately tapering above the occipital furrow, and broadly rounded in front; marked by three pairs of distinct transverse furrows, which are directed obliquely backward from their outer ends; the posterior pair almost or quite meeting in the middle, the others shorter, and situated at almost equal distances from each other. Occipital furrow well marked, proportionally wide and shallow; occipital ring narrow, not well defined.

Fixed cheeks very broad, nearly two-thirds as wide as the glabella, depressed-convex; frontal limb short, the border and inner part of nearly the same width; sides of the limb in front, wide, and slightly rounded at the antero-lateral angles; posterior limb wide at its junction with the glabella, and rapidly narrowing outward, being about once and a half as long as its greatest width; ocular ridges slender, but very distinct; rising from the anterior angle of the eye and uniting with the glabella near the anterior furrow, forming a slightly curved line parallel with the marginal furrow of the head.

Facial sutures directed inward from the anterior margin of the head to the eye-lobe, behind which they are directed outward and backward to the posterior margin of the head, at an angle of about forty degrees to the occipital line.

A form of movable cheek found associated in considerable numbers with the glabellas, and corresponding in size and character, is narrowly triangular, the posterior extremity terminating in a short, blunt spine, slightly curved; inner angle strongly notched for the reception of the eye-lobe, and the outer margin bordered by a thickened, rounded rim, which gradually increases in width to the base of the spine. The facial suture corresponds to the margin of the fixed cheek above described, and, on the under side, the anterior border is prolonged in the form of an acute process, to extend along the anterior border of the frontal limb.

The pygidium associated with the above specimens is minute, transversely subelliptical in form, most strongly rounded on the front border, with a wide axis terminating obtusely a little within the posterior margin. The axis is marked by five rings, exclusive of the terminal ones. Lateral

lobes convex, marked by three or four divided ribs, exclusive of the anterior single one.

Surface of the head and cheeks marked by fine anastomosing lines, radiating from the eye and front of the glabella.

Formation and locality.—In dark greenish, thinly-laminated shales of the Quebec group, in cañon above Call's Fort, Wahsatch Range, Utah. Collected by S. F. Emmons, esq.

Genus DIKELLOCEPHALUS Owen.

DIKELLOCEPHALUS QUADRICEPS n. sp.

Plate I, figs. 37-40.

Glabella and fixed cheeks united, quadrangular in form, with a regularly and symmetrically arcuate front margin. Glabella elongate quadrangular, a little expanded and rounded in front, three-fourths as wide across the middle as the length above the occipital furrow, very gibbous or somewhat inflated; marked by three pairs of transverse furrows, which extend about three-fourths of the distance to the center, not in the least oblique, and so faint as to be detected only on the closest examination, or by the reflection of light along the surface; occipital furrow very distinct; ring strong and robust, supporting a strong, thickened spine of undetermined length on the posterior margin. The base of the spine is broad, and the spine directed backward and upward.

Fixed cheeks of moderate size, strongly convex, a little more than one-third as wide at the eye as the width of the glabella, and rapidly declining to the antero-lateral angles. Eye-lobes small, situated rather behind the middle of the length of the head; ocular ridges distinct, strongly directed forward in their passage from the eye to the glabella. Frontal limb very short, not extending beyond the frontal margin of the glabella, and strongly curving backward to the point of intersection with the facial sutures.

Facial sutures commencing at the anterior margin on a line with the inner angle of the eye-lobe, and running directly back to the eye in a straight line; behind the eye, the direction is outward, but its exact course has not been ascertained. Lateral limb not observed.

A pygidium associated with the glabella is paraboloid in form, and

surrounded on the margins by twelve short, rather strong spines, the four on the posterior margin being shorter than the others. Axis narrow, highly convex, two-thirds as long as the shield, and marked by four rings, exclusive of the terminal ones. Lateral lobes broad, convex, and marked by four low, rounded ribs, the anterior one much narrower than the others; each of the four ribs terminating in one of the lateral spines.

There can be no doubt that the above-described pygidium belongs to the same species with the associated glabella, as they are both equally abundant, and are the only trilobitic remains brought from the locality, except those of *Conocephalites subcoronatus*. The glabella is enlarged to three diameters in the figure, while the pygidium is given natural size, but is one of the largest individuals seen; while there are fragments of glabellas in the rock fully twice the size of the specimen figured. The species bears a very close resemblance to *D. gothicus*, herein described, but differs principally in the simple ribs; while in that species they are divided, a feature that will very readily distinguish the two forms.

Formation and locality.—In limestone of the age of the Quebec group, from the base of Ute Peak, Wahsatch Range, Utah. Collected by Arnold Hague, esq.

DIKELLOCEPHALUS WAHSATCHENSIS n. sp.

Plate I, fig. 35.

Glabella elongate-quadrangular, with parallel lateral margins and slightly-rounded front; height and width about as four to three; very depressed-convex, and marked by two pairs of transverse furrows, which do not quite meet in the center, dividing the glabella into three nearly equal portions. Occipital furrow narrow, not strongly defined; ring narrow, distinct, and bearing a slender spine on the center; dorsal furrows narrow and poorly defined.

Fixed cheeks wide and flattened; ocular ridges faintly marked, rising opposite the anterior furrow of the glabella, and directed slightly backward to the eye-lobe. Frontal limb very short and wide, the marginal rim regularly arcuate, narrow, and prominent, closely cutting the front of the glabella. Facial sutures not fully determined, but are distinct on the anterior margin, cutting the rim with a strong outward curvature, and again

recurving to the eye, leaving the limb nearly two-thirds as wide at its widest point as the glabella.

This species differs from any other described in the length of the glabella and the position of the furrows, in the short frontal limb, and great lateral extension of the same. No other parts of the species have been recognized. There are, however, several specimens of a pygidium associated in the same slates, and, as they are the only remains of Trilobites occurring in the slates, except *C. (L.) quadrans*, which cannot well be confounded with either, it would be natural to suppose they were parts of the same species. But the characters of the pygidium are so unlike anything heretofore recognized or known to belong to the genus *Dikellocephalus*, that we have great doubt of their generic identity, and for that reason have placed them under different specific names with a doubt as to the generic reference.

Formation and locality.—In green argillaceous slates of the Quebec group, in the cañon above Call's Fort, Wahsatch Range, Utah. Collected by S. F. Emmons, esq.

DIKELLOCEPHALUS? GOTHICUS n. sp.

Plate I, fig. 36.

Pygidium semi-ovate, or short paraboloid, with a very strong central axis, and spinose margin; anterior margin straightened for about two-thirds the width of the lateral lobes, where it curves abruptly backward to the lateral angles. Axial lobe strong, cylindrical, and prominent, forming one-third of the entire width exclusive of the spines, and reaching almost to the posterior margin of the shield; obtusely rounded at the extremity, and marked by six annulations exclusive of the terminal ones. Lateral lobes very moderately convex, and marked by four divided ribs on each side, each terminating in a strong and proportionally long marginal spine; central area of each rib depressed, forming a flattened groove, extending to the base of the marginal spine. Borders of the ribs elevated, the anterior one strongest and prominent, gradually widening from its origin to the margin of the shield; posterior border narrow and rounded, separated from the next succeeding rib by a sharply-depressed, narrow groove. This peculiar form

of rib gives to the shield an appearance similar to the groining of a Gothic arch. Margin of the shield surrounded by twelve long, rather strong spines, four of which, on each side, are about equal in size and strength, while the four occupying the posterior border are shorter and unequal, those in the middle being the shortest.

The peculiar feature of the specimen consists in the divided ribs of the lateral lobes and spinose margin. In these features, it differs from all others known, and may possibly, when better material shall be examined, showing other parts of the organism, require a distinct generic name.

Formation and locality.—In greenish argillaceous slates of the Quebec group, in the cañon above Call's Fort, north of Box Elder Cañon, Wahsatch Mountains, Utah. Collected by S. F. Emmons, esq.

Genus BATHYURUS Billings.

BATHYURUS POGONIPENSIS n. sp.

Plate I, figs. 33-34.

The species is recognized only by the pygidium, which is rather small, measuring a little less than three-fourths of an inch in the greatest transverse width, by a length of a little less than half an inch. Form transversely elliptical, the posterior margin nearly twice as convex as the anterior border; lateral extremities angular; axis narrow, forming only about one-fourth of the entire width, highly convex, and about three-fourths as long as the entire shield, extremity obtusely rounded and terminating abruptly; marked by four transverse annulations exclusive of the terminal ones, the posterior one being as long as the two next preceding it; rings highly convex and rounded, with interspaces of nearly equal dimensions. Lateral lobes broad and somewhat triangular; the inner third of the width horizontal, beyond which the surface slopes rapidly to the outer margin; marked by three broad, slightly flattened, but strong and very distinct ribs, which terminate about one-third of the width within the margin, leaving a plain border surrounding the shield. The two anterior ribs are broad, and show a faint depression along the middle in the upper part. Surface of the crust, under an ordinary magnifying power, apparently smooth, except on the crest of the axial rings, where there are a few node-like granules

The pygidium is associated with a granulose glabella of corresponding dimensions, which is too imperfect for illustration or description, but probably of the same species. The sides are parallel or slightly widening anteriorly, and the front rounded. The entire surface is covered with small, closely-set pustules. The glabella bears considerable resemblance to that of *B. strenuus* Bill. (Pal. Foss. Canada, vol. 1, p. 204), but shows indications of a faint glabellar furrow behind the middle of the length.

Formation and locality.—In coarse, crystalline limestones, on the west side of Pogonip Mountain, White Pine, Nevada. Collected by A. J. Brown, esq.

Genus OGYGIA Brongn.

OGYGIA PRODUCTA n. sp.

Plate II, figs. 31-34.

Glabella very much elongated, twice as long as wide, measuring from the occipital furrow; slightly expanded in front, and rounded on the anterior extremity; convex and subangular along the median line; marked by two pairs of faint, very oblique furrows, which do not quite meet in the middle. Occipital furrow broad and distinct; ring strongly marked and thickened in the middle.

Fixed cheeks of moderate width; eye-lobes large, two-thirds as long as the glabella, extending from the occipital furrow to the middle of the anterior lobe of the glabella; distinctly marked by a narrow, depressed furrow just within and parallel to their margins. Lateral limbs narrow. Frontal limb unknown.

Movable cheeks obliquely triangular, the outer face being much the longest, and regularly arcuate; posterior extremity rounded, showing no evidence of a spine in the impression of the under surface, though the upper portion may have borne a spine, as seems to be indicated by other impressions of the exterior. Ocular sinus very large, but shallow, regularly arcuate; surface of the cheek depressed-convex, with a faint, shallow groove just within the margin and a scarcely thickened rim beyond.

Thorax depressed-convex, distinctly trilobed. Axis narrower than the lateral lobes, and gradually tapering from the occipital region posteriorly, and

slightly convex; annulations indistinctly marked. Pleura curving backward near the outer ends and pointed at the extremity; marked along the middle by a broad, shallow furrow, which occupies one-half of the width for a distance of nearly two-thirds the length of the rib, becoming obsolete near the free flattened extremity.

Pygidium broadly elliptical, scarcely twice as wide as long, anterior face much less convex than the posterior, which sometimes becomes irregularly paraboloid in the slate from distortion. Axial lobe less than one-third of the entire width, and rapidly tapering posteriorly; about four-fifths as long as the shield, and terminating just within the rather broad, recurved marginal lining of the under surface in an obtusely-rounded point; axis marked by six strong, rounded rings, exclusive of the terminal one; lateral lobes depressed-convex, marked by three or four obscure ribs, which, when compressed in the slates, become very faint and obscure.

The material from which the above description is taken is in a very unsatisfactory condition, being fragmentary and much distorted by the slipping and contortions of the shale in which they are imbedded, so that the features of form as here given may be somewhat modified on finding other and more perfect material. The great length of the glabella will serve as a distinguishing feature in the identification of the species.

Formation and locality.—In greenish and reddish shales of the age of the Quebec group, at East Cañon, Oquirrh Mountains, Utah. Collected by J. E. Clayton and S. F. Emmons.

OGYGIA PARABOLA n. sp.

Plate II, fig. 35.

Pygidium long-paraboloid, posterior to the antero-lateral angles, with a slight emargination at the posterior border; front margin somewhat irregularly arcuate; surface flattened, or very gently convex, and in the cast showing a very wide marginal lining on the under surface, which extends to nearly one-half the width of the lateral lobes on the anterior margin, and very gently widening posteriorly. Axis convex, wide and bulbous in front, narrowed and cylindrical below for about four-fifths of its length; the anterior bulbous portion forming a single strong annulation, once and a

half as wide as the cylindrical portion below, which appears to be smooth and destitute of rings. Lateral lobes also marked by a single, wide, flattened rib, corresponding to the annulation of the axis, and a narrow, sharply-elevated, anterior ridge, corresponding to the articulating projection of the axis.

The pygidium is all that has yet been recognized of this peculiar species, but it is so marked in its characters that we have no hesitation in pronouncing it distinct from any hitherto described. The absence of rings on so great a length of the axial lobe is a marked and distinguishing feature.

Formation and locality.—In greenish shales of the age of the Quebec group, at East Cañon, Oquirrh Mountains, Utah. Collected by S. F. Emmons and J. E. Clayton.

FOSSILS OF THE DEVONIAN.

BRACHIOPODA.

Genus STROPHODONTA Hall.

STROPHODONTA CANACE.

Plate III, figs. 1-3.

Strophodonta Canace H. & W., 23d Rept. St. Cab., p. 236, pl. II, figs. 8-11.

Shell of medium size, subquadrangular in outline, wider than long; hinge-line a little shorter than the greatest width of the shell, the external border very gently sloping from the middle to the extremities; lateral margins and basal border of the shell somewhat straightened, and the angles rounded. Ventral valve convex, slightly geniculated near the middle of its length, and flattened on the umbonal disk; cardinal area narrow, sublinear or moderately decreasing in width from the middle outward, vertically striated or crenulate and divided in the center by a narrowly triangular fissure. Dorsal valve concave, a little more than half as deep as the convexity of the ventral; area very narrow. Surface of the ventral valve marked by strong, sharp, distant, radiating striæ, with concave interspaces, which are occupied by three or more finer, even striæ. Surface of the

dorsal valve marked by fine, even striae. The specimen measures about seven-eighths of an inch in length by a little more than an inch in width; convexity of the ventral valve about five-sixteenths of an inch.

The specimen possesses all the essential specific characters of the Iowa shells, but differs slightly in the more decidedly quadrangular outline. This feature alone, however, cannot be considered of specific importance, since, among the typical specimens, the variation in this respect is considerable.

Formation and locality.—In limestone of Devonian age, at Treasure Hill, south of Aurora Mine, White Pine, Nevada. Collected by Arnold Hague, esq.

Genus RHYNCHONELLA Fischer.

RHYNCHONELLA EMMONSI n. sp.

Plate III, figs. 4-8.

Shell rather above the medium size, globosely subcuboidal, very ventricose, highly gibbous on the dorsal side, shallow and somewhat flattened on the ventral and squarely truncate in front; cardinal margin broadly rounded, the small, pointed, ventral beak projecting beyond the general contour, and having the appearance of a small cardinal area from the projection of the margin of the foramen, into which the beak of the dorsal valve passes; sides of the shell more sharply rounded than the cardinal border. Front of the ventral valve abruptly bent upward in a broad, linguiform extension, nearly or quite equal to the entire height of the shell, and almost two-thirds as wide as the entire width; the sides of the extension are straight and parallel for most of the height, the top being broadly and evenly rounded. Dorsal valve emarginate in front, corresponding with the extension of the ventral valve.

Surface marked by from twenty-three to twenty-five low, rounded, simple plications on each side of the elevation and sinus, and about fourteen on the elevation of the dorsal valve, with a corresponding number on the extension of the ventral valve.

The species is of the type of *R. cuboides* of Europe and *R. venusta* Hall, of the Tully limestone of New York. It differs from the former in its much less cuboidal form and broader and shorter proportions, and from the latter

in the same particulars, as well as the finer and more numerous plications, and in the want of the flattening of these latter on the front of the shell.

Formation and locality.—In limestones of Devonian age, south of Aurora Mine, White Pine, Nevada. Collected by Arnold Hague, esq.

LAMELLIBRANCHIATA.

Genus PARACYCLAS Hall.

PARACYCLAS PEROCCIDENS n. sp.

Plate III, figs. 14-17.

Shell comparatively large, circular in outline, with scarcely projecting, but well-marked beaks; valves ventricose, somewhat inflated along the strongly-curved or convex umbonal ridge; cardinal line strongly arcuate, but becoming slightly alate toward the posterior end, especially perceptible on the internal casts; anterior side of the shell marked by a slight constricting sulcus, or depression, extending from the front of the beaks to the margin of the shell just below the middle of the anterior side, strongly reminding one of the similar constriction on many of the recent *Lucinas*; beaks pointed and strongly curving forward, situated well anteriorly. On the internal casts, the muscular impressions are large and strongly marked, the posterior one is irregularly quadrangular, and the anterior one reniform, widening below, and not more than half as large as the posterior; pallial line consisting of strong longitudinal pustules, arranged side by side.

Surface of the shell somewhat roughened by strong, irregular, but not lamellose, concentric undulations formed by aggregating lines of growth.

The shell differs from any form previously described in this country in the presence of the anterior constriction, but, in many other respects resembles *P. elliptica* var. *occidentalis* H. & W., from the Upper Helderberg limestones of Southern Indiana.

Formation and locality.—In dark limestone of Devonian age, at Treasure Hill, south of Aurora Mine, White Pine. Collected by Arnold Hague, esq.

Genus NUCULITES Conrad.

NUCULITES TRIANGULUS n. sp.

Plate III, figs. 12-13.

Shell comparatively large for the genus, subtriangular in outline, about

four-fifths as high as long; valves depressed-convex, perhaps partly due to compression; beaks large, broad, and prominent, situated about one-third of the length from the anterior end; posterior cardinal margin rapidly sloping to below the middle of the valve, from which point the posterior end rounds forward to the straight basal line; anterior end rounded, its greatest length being much below the middle of the valve, above which the margin is concave to just below the beak. Teeth and hinge unknown. On removing the shell from a portion of the valve, a slight impression was seen on the cast anterior to the beak, resembling that left by the removal of a muscular clavicle, or ridge, but not quite satisfactory in its character.

Surface of the shell marked only by moderately strong, irregular, concentric undulations.

The general form of the shell is much like that of *N. triquetra* Con. from the Hamilton group of New York, but with a straighter basal line, much larger and tumid beaks, and of very much greater size than is known in that species.

Formation and locality.—In the lower black slates of the White Pine District, near Eberhardt Mill. Collected by Arnold Hague, esq.

Genus LUNULICARDIUM Munster.

LUNULICARDIUM FRAGOSUM.

Plate ^{III} II, figs. 9-11.

Posidonomya? fragosa, Meek. (Part I, page 92 and Plate.)

The specimens figured and described by Mr. Meek, under the name *Posidonomya? fragosa*, prove, on carefully uncovering the cardinal portions of the specimens, to belong to the genus *Lunulicardium*, a genus, so far as we are aware, that has only been recognized in rocks of Devonian age, unless the genus *Chænocardia* M. & W. should prove to be identical, about which we have some doubt. In the rocks of this age in New York, it has been recognized in several species, ranging from the Marcellus shales to the Chemung group inclusive, one or more species being known in each formation. The shells are readily recognized by the broadly gaping anterior (?) end, bordered by a more or less reflected margin or flange-like projecting border, extending from the beak to the basal margin, which we presume is analogous to the byssal opening in other forms of shell. The species

under consideration shows this feature on several specimens in the collection in a somewhat remarkable degree. The flange widens and is somewhat roundly pointed in some cases near the beak, and gradually narrows below. The general form of the shell is obliquely ovate, widest below, varying much, however, in different examples. The substance of the shell has been thin, and marked by comparatively strong concentric undulations, but without other surface-characters.

Mr. Meek's figures are true in all respects, except in wanting the flange-like border; and the figures given on plate 3 are for the purpose of illustrating this feature. The species has considerable resemblance to *L. fragilis* = *Avicula fragilis* Hall (Geol. 4th Dis. N. Y., 1843, p. 222, figs. 1-2) (fig. 2, *loc. cit.*, falsely represents a posterior wing), from the Genesee slate and Portage group of New York, but differs materially in the greater elongation of the valves. Examples could, however, be selected from among the New York collections that would exceed in length the shorter form from the black slates of the White Pine District, while the peculiarity of having the flange widening near the beak is a feature noticed only in that species among all of those recognized in the New York formations, and is one that shows the close relations of the two species. The greater proportional length of the shells of this one will serve to distinguish them.

GASTEROPODA.

Genus BELLEROPHON Montf.

BELLEROPHON NELEUS n. sp.

Plate III, figs. 18-20.

Shell rather above the medium size, nearly globular in form, a little wider than high. Volutions rounded and very slightly carinate on the back, the keel showing only as a low, rounded, scarcely elevated band on the internal cast. Lip somewhat expanded laterally, the outer axial margin forming a strong auriculation on each side of the shell; margin of the lip bilobed, deeply and broadly notched in the middle; the sides of the notch moderately expanding at first, but more rapidly above; lobes of the lip rounded. Umbilicus closed, but on the internal cast showing as of consid-

erable width from the great thickness of the shell. The inner lip, as seen on a specimen preserving this part of the shell, is much thickened and forms a callus, slightly trilobate and strongly modifying the form of the aperture. Aperture semilunate or reniform, about twice as wide as long. A fragment of the exterior surface preserved is covered with oblique rows of closely crowded, rounded granules, or small tubercles, outside of the median band; the obliquity of the rows being caused by the quincunx arrangement of the tubercles. The form and ornamentation of the revolving median band has not been fully determined, but is apparently broad and flattened, with retrally curved striae.

The species very closely resembles, and is probably identical with, an undescribed form from the Chemung group of New York; being similar in size, form, and surface-markings, as well as in the solid axis and form of the callus of the inner lip. It differs in the surface-markings from any described form with which we are acquainted.

Formation and locality.—In limestone of Devonian age, at Treasure Hill, south of Aurora Mine, White Pine District, Nevada. Associated with *Strophodonta Canace*, *Rhynchonella Emmonsii*, *Paracyclas peroccidens*, and other Devonian forms. Collected by Arnold Hague, esq.

FOSSILS OF THE WAVERLY GROUP.

RADIATA.

Genus MICHELINA D'Kon.

MICHELINA ——— sp. ?.

Plate IV, fig. 19.

Among the fossils received from Dry Cañon there occurs a worn specimen of this genus, composed of tubes which vary from an eighth of an inch in diameter to nearly or quite twice that size. The corallum seems to have been highly convex, but not hemispherical in form, with few but rapidly diverging tubes of moderate size. The specimen is imbedded in the rock so as to expose the lower part of the tubes cut transversely. The walls have been quite thick at this point, but become much more attenuate

or even quite sharp on their upper edges. The specimen is in such a state of preservation that it is impossible to detect the specific characters, and is chiefly interesting on account of the association in which it is found. The genus *Michelina* is not common in this country in rocks above the Devonian, although very abundant in many of the formations of that series, and has been recognized in several species in the Carboniferous rocks of Europe. This species, therefore, furnishes another instance of the mingling of Devonian and Carboniferous forms in the rocks of the age to which we suppose these to belong (viz, Waverly group), showing intimate relations, if not absolute transition without break, from the Devonian to the Lower Carboniferous in several widely distant parts of the country.

BRACHIOPODA.

Genus STREPTORHYNCHUS King.

STREPTORHYNCHUS EQUIVALVIS.

Plate IV, figs. 1-2.

Orthis equivalvis Hall, Geol. Rept. Iowa, vol. 1, pt. 2, p. 490, pl. 2, fig. 6.

Specimens of a species of *Streptorhynchus*, having characters very similar to many of those occurring in the Burlington sandstones, occur in the rocks of this formation at Ogden and Logan Cañons, Wahsatch Range, Utah. The shell is at all times a very variable one, and not easily determined with satisfaction. The specimen represented by fig. 1, plate IV, is rather wider than most of those above referred to, but resembles them in form except in this particular, and in want of the sinus which often marks them. The alternations of coarser and finer striæ is a common character. The specimen represented by fig. 2 of the same plate is also a not unusual form, although shorter than the generality of individuals. The specimen fig. 1 is from Ogden Cañon, and fig. 2 from Logan Cañon. Collected by S. F. Emmons, esq.

STREPTORHYNCHUS INFLATUS.

Plate IV, fig. 3.

Streptorhynchus inflatus White & Whitfield, Proc. Bost. Soc. Nat. Hist., vol. viii, 1862, p. 293.

The specimen fig. 3, plate IV, possesses the character of the above-cited species in all particulars as far as can be ascertained from the specimen, except

that it is a little wider, but not sufficiently so to be considered beyond the limits of specific variation. The shell is very gibbous, in fact quite inflated in form, and evenly striate. Other individuals show the large cardinal process known to exist in the original, and, considering the extreme variations to which species of this genus are subject, we see no reason why this should be considered as distinct from the typical forms.

Formation and locality.—In limestones of the age of the Waverly group, at Dry Cañon, Oquirrh Mountains, Utah. Collected by S. F. Emmons, esq.

Genus STROPHOMENA Rafinesque.

STROPHOMENA RHOMBOIDALIS Wilckens.

Plate IV, fig. 4.

For synonymy see Palæont. N. Y., vol. iv, p. 76.

The examples of this species observed present a broad flattened surface with but a slight geniculation, the flattened portion being covered by close, rather small, or narrow, concentric wrinkles, which are crossed by fine radiating striæ. The form is similar to those found in the yellow sandstones of Burlington, Iowa. The straight hinge-line is about as long as the width of the shell below, or a little shorter, and the length of the shell about two-thirds as great as the width. The geniculation is near the margin; the flattened disk occupying almost the entire extent of the shell. Only the ventral valve has been observed.

Formation and locality.—In limestone of the age of the Waverly group, Dry Cañon, Oquirrh Mountains, Utah. Collected by J. E. Clayton, esq.

Genus CHONETES Fischer.

CHONETES LOGANENSIS n. sp.

Plate IV, fig. 9.

Shell of moderate size, semicircular; hinge-line straight, longer than the width of the shell below; the extremities acutely angular. Ventral valve convex, with a slight flattening, scarcely a depression, along the median line, widening gradually toward the front; sides of the valve rounded,

becoming flattened, or very faintly concave, near the hinge-extremities; hinge-line marked by three or four very short, appressed spines on each side of the beak. Dorsal valve and area of the ventral unknown. Surface marked by very fine, closely crowded, radiating striæ; the number not determined, owing to the exfoliated condition of the shell.

The species resembles somewhat *C. Illinoisensis* Worthen, from the Burlington limestone, in the size and convexity of the valve, and also in the striæ, but differs in the greater proportional length of the hinge-line and in the flattening of the mesial portion.

Formation and locality.—In limestone of the age of the Waverly group, at Logan Cañon, Wahsatch Range, Utah. Collected by S. F. Emmons, esq.

Genus SPIRIFERA Sow.

SPIRIFERA CENTRONATA.

Plate IV, figs. 5-6.

Spirifera centronata Winchell, Proc. Acad. Nat. Sci. Phil., 1865, p. 118.

Shell rather below the medium size, transversely elongate, with mucronate extensions, exclusive of which the front margin of the shell forms nearly a semicircle, the length from beak to front being sometimes greater and sometimes less than half the length along the hinge. Valves convex, the ventral most ventricose, with a moderately sized, rather pointed beak, which is slightly incurved and projecting beyond the hinge-line. Area narrow; mesial sinus distinct, narrow, angularly defined at the margins, and extending to the beak; occupied by from three to five plications near the front, formed by the bifurcation of two, which originate at the beak. Sides of the shell marked by from twelve to eighteen or twenty plications, mostly simple, but sometimes bifurcating. The plications are slender and rounded, not very angular. Dorsal valve depressed-convex; the narrow fold well defined, but not highly elevated. Minute surface-characters not observed, as the specimens are all in a state of exfoliation.

This species seems to be a common form in the rocks near the base of the Wahsatch limestone. It is subject to some variation in external form and number of plications, but is readily recognized and identified.

Formation and locality.—Near the base of the Wahsatch limestone (Wav-

erly?), at Dry Cañon, Oquirrh Mountains, Logan and Ogden Cañons, Wahsatch Range, Utah, collected by S. F. Emmons, esq. We have also seen several specimens of it in collections from a white limestone brought from the Black Hills by Mr. G. Bird Grinnell, in 1874.

SPIRIFERA ALBA-PINENSIS n. sp.

Plate IV, figs. 7-8.

Compare *Spirifera biplicatus* Hall, Geol. Rept. Iowa, vol. 1, pt. ii, pl. 7, fig. 5, p. 519.

Shell rather below a medium size, transversely elongate, greatly extended on the hinge-line, with submucronate extremities; the width or length along the hinge equal to about twice the length from beak to front. Ventral valve ventricose, regularly arcuate from beak to front, the margin of the valve forming nearly a semicircle exclusive of the hinge-extremities; beak of moderate size, incurved and pointed; area moderate; a narrow, rather shallow, and not distinctly defined mesial sinus marks the center of the valve, and is bordered on each side by a broad, rounded plication, much stronger and more elevated than the others, and which is divided along the middle on the lower half of the shell by a slightly impressed line, giving it the appearance of a bifurcated rib. The middle of the sinus is sometimes smooth, and in some cases marked by two or three faint plications, which do not extend beyond the anterior half of the shell. Besides the strong plications bordering the sinus, there are from fourteen to eighteen low, rounded, simple plications on each side, six or eight of which on the outer end of the valve are often very obscure and sometimes obsolete. Dorsal valve unknown.

This species is very closely related to, and may possibly prove to be identical with, *S. biplicatus* Hall (*loc. cit.*), from the Burlington sandstones of Iowa, but it appears to differ in not possessing the central depressed line on the mesial fold, if it is safe to rely upon the evidence furnished by the absence of a corresponding fold in the sinus of the ventral valve and the presence of two or more obscure plications in its place. As the dorsal valve has not been observed, although several ventrals have been examined, these differences cannot be positively affirmed.

Formation and locality.—In limestones near the base of the Wah-

satch limestone, at Dry Cañon, Oquirrh Mountains, Logan and Ogden Cañons, Wahsatch Range, Utah, and from a band of chert beneath the upper black slates of the White Pine District. Collected by J. E. Clayton, S. F. Emmons, and Arnold Hague.

Genus *ATHYRIS* McCoy.

ATHYRIS CLAYTONI n. sp.

Plate IV, figs. 15-17.

Shell of moderate size, oval or very slightly ovate in general outline when viewed from the dorsal side, the entire length being one-sixth greater than the greatest width, and the rostral half of the shell being slightly more attenuated than the forward part. Valves moderately and nearly equally convex. Dorsal valve nearly circular in outline, convex, most ventricose in the upper part, and somewhat angular along the middle throughout, but not forming any distinct mesial elevation; beak small, incurved, and rather pointed, the apex passing within the fissure of the opposite valve. Ventral valve much longer than the dorsal, the rostral half very ventricose, but becoming somewhat flattened on the antero-median portion, without forming a distinct sinus; beak large and tumid, abruptly curved upward, and rather strongly truncated at the apex on a line with the plane of the valves; cardinal margins strongly inflected or enrolled, almost presenting the appearance of a cardinal area, but without any defined limits; fissure large, broadly triangular, and partly filled by the dorsal beak. Surface of the valves smooth, except a few strong concentric lines marking stages of growth.

The species is peculiar in shape, the cardinal portion presenting so much the appearance of a species of *Spirifer* of the type of *S. Maia* Bill., as figured in Pal. N. Y., vol. 4, pl. 63, fig. 8, as to be readily mistaken for one of that group; but the entire absence of a defined cardinal area, together with the perforated beak, readily distinguishes it on a closer inspection. The absence of any defined mesial fold and sinus is also a good specific character.

Formation and locality.—In limestones of the Lower Carboniferous (Waverly?) age, Little Cottonwood, 800 feet east of Reed and Benson's

mine, Wahsatch Range, Utah. Named in honor of Prof. J. E. Clayton, of Salt Lake City, Utah, to whom we are indebted for the use of the specimens.

ATHYRIS PLANOSULCATA?

Plate IV, figs. 10-11.

Compare *Athyris planosulcata* Phil., Geol. Yorkshire, vol. ii, p. 220, fig. 15.

A small species of *Athyris* not readily identified with any known species, and yet so closely resembling several described forms, that it is difficult to cite differences which would distinguish it from them, occurs associated with the fossils described from the Cottonwood divide. It is of medium size, nearly circular in outline, with ventricose valves and destitute of mesial fold or sinus; beaks small, that of the ventral valve incurved and but slightly truncated by the small foramen. The surface of the shell is smooth except from concentric lines marking stages of growth, and entirely destitute of any marked or distinguishing feature. The specimens are of the size and general appearance of those usually referred to *A. planosulcata* Phil., and from its lack of distinguishing features we hesitate to refer it with certainty to any known species.

Formation and locality.—In limestone of the Lower Carboniferous (Waverly?) age, Cottonwood divide, 800 feet east of Reed and Benson's mine, Wahsatch Range, Utah. Collected by J. E. Clayton.

Genus *RHYNCHONELLA*, Fischer.

RHYNCHONELLA PUSTULOSA White?.

Plate IV, figs. 12-14.

Rhynchonella pustulosa White, Jour. Bost. Soc. Nat. Hist., vol. viii, p. 226.

Shell small, transversely subtrigonal, with a broadly rounded front and straightened cardinal slopes; sides of the shell sharply rounded; beak pointed and projecting; valves ventricose, the dorsal the most gibbous.

Surface marked by from sixteen to twenty-two simple rounded plications, five of which are elevated in the middle, to form the proportionally broad mesial elevation, and a corresponding number depressed on the ventral forming the sinus.

The specimens of this species seen are mostly poor; one, however, preserves the form and features, with but little or no distortion, giving the characters as above. The shell varies considerable from the description of Dr. C. A. White; but, on comparison with a group of several individuals from the typical locality, sent by Dr. White as of that species, we find the variations great enough to include specimens departing still further than these here referred. The minute surface-structure having pustules has not been observed among those in this collection, as they are all more or less exfoliated, and it does not appear to be commonly preserved on those from the typical locality. The greater number of plications would seem to be a distinguishing feature, but eight of the twenty-two counted occur on the cardinal slopes, where, in very many cases, they might not be distinguishable.

Formation and locality.—In limestone of the Waverly group, at Logan Cañon, Wahsatch Range, Utah. Collected by S. F. Emmons, esq.

Genus TEREBRATULA (Llhwyd.) Brug.

TEREBRATULA UTAH n. sp.

Plate IV, fig. 18.

Shell of medium size, elongate-ovate, the greatest width opposite the middle of the dorsal valve, forward of which point the sides are somewhat rapidly contracted to the rather squarely truncated front margin. Valves ventricose, the ventral more gibbous than the opposite. Dorsal valve most ventricose within the upper third of the valve; beak small and sharply pointed for a dorsal beak, scarcely if at all incurved. Surface of the shell smooth, with the exception of several rather strong concentric lines marking stages of growth. Beak of ventral valve not observed.

The shell is described from a separate dorsal valve and a partially concealed ventral valve, but the form of the shell is somewhat different, and the proportions unlike any other known from rocks of a corresponding age.

Formation and locality.—From a dark limestone of Lower Carboniferous age (Waverly?), on the Cottonwood divide, 800 feet east of Reed and Benson's mine, Wahsatch Range, Utah. Collected by J. E. Clayton.

GASTEROPODA.

Genus EUOMPHALUS Sow.

EUOMPHALUS (STRAPAROLLUS) UTAHENSIS n. sp.

Plate IV, figs. 20-23.

Shell of medium size, discoidal, composed of about four volutions, which are coiled nearly or quite in the same plane, and in close contact with each other, but not embracing or overlapping, and but moderately increasing in diameter with increased growth. On the upper surface, the volutions are marked, near the middle of their diameter, by a narrow, sharply elevated band, or carina; within which the surface slopes rapidly and evenly to its contact with the preceding whorl; outside of the carina, the volution is evenly and regularly rounded across the dorsum and to the edge of the broad, open umbilicus, where there is a nearly obsolete angularity, situated considerably within the middle of the volution; within the umbilicus the surface is somewhat evenly rounded. The surface of contact of each volution with the preceding one is very narrow and slight, leaving the inner ones projecting on the sides of the shell, exposing the greater part of each volution.

Surface of the shell marked by rather distinct transverse lines of growth, which are sometimes grouped so as to form slight transverse undulations on the larger part of the shell. These lines have a slight outward convexity on that portion within the carina of the upper side, and on the outer portion a somewhat retral curvature as they cross the body of the volution.

The species is of the type of *Euomphalus pentangularis* Sow., and somewhat closely resembles *S. similis* var. *planus* M. & W. (Geol. Rept. Ills., vol. ii, pl. 19, fig. 5), but differs in the sharp carina of the upper side, and in having the volutions coiled more decidedly in the same plane. This shell also attains a much greater size than that one is known to do; the largest specimen observed having a diameter of nearly an inch and two-thirds. It is also related to *S. planodorsatus* of the same authors (*loc. cit.*, pl. 24, fig. 2), but is readily distinguished by the form of the upper surface of the volution.

Formation and locality.—In limestone near the base of the Wahsatch limestone, of the age of the Waverly group, at Dry Cañon, Oquirrh Mountains, Ogden and Logan Cañons, Wahsatch Range, Utah. Collected by J. E. Clayton and S. F. Emmons.

EUOMPHALUS LAXUS.

Plate IV, figs. 24-25.

Euomphalus laxus White, MSS. Lieut. Wheeler's Rept. of Geograph. and Geol. Surv. and Expl. W. of 100th Meridian.

Shell subdiscoidal; the height of the spire above the body of the last volution equal to from one-third to about one-half its diameter, the inner volutions being scarcely elevated above the general plane. Umbilicus broad and proportionally deep, exposing all the inner whorls. Volutions three or more, seldom, however, exceeding four; rather slender in their proportions; the last one more rapidly increasing in size than the others; obscurely pentangular in transverse section; the periphery being obtusely angulated just below the middle, slightly flattened above the angle, and distinctly so on the upper surface. The lower side of the volution is gently rounded on the outer part, but more sharply curved at the edge of the broad open umbilicus.

Surface of the shell marked by distinct, somewhat irregular, lines of growth, parallel to the margin of the aperture, their direction being nearly at right angles to the axis of the shell, with a very slight sinuosity as they cross the upper flattened surface of the volution.

The species is a well-marked one, and appears to be quite characteristic of beds near the lower part of the Wahsatch limestone, Wahsatch Range, Utah. It bears a strong resemblance to specimens of *E. laxus* H. from the Burlington limestones, but the volutions increase much more rapidly, and the flattened space on the upper side is narrower in proportion to the diameter of the volution than in those specimens, and it is also a much smaller form. It also bears considerable resemblance to an angulated form in the Burlington sandstones, usually referred to *E. cyclostomus* H., but probably distinct. There is also a species in the Chemung group of New York very closely resembling this one, but which does not show the angularity of the

periphery, although flattened on the top of the volution. The individual figured is somewhat smaller than the specimen used and figured by Dr. C. A. White in Lieutenant Wheeler's Report above cited, but possesses all the characters of those specimens.

Formation and locality.—In limestones near the base of the Wahsatch limestone, of the age of the Waverly group of Ohio, at Dry Cañon, Oquirrh Mountains, and Logan Cañon, Wahsatch Range, Utah. Collected by S. F. Emmons and J. E. Clayton.

EUOMPHALUS (STRAPAROLLUS) OPHIRENSIS n. sp.

Plate IV, figs. 26-27.

Shell of medium size, broadly conical or subtrochiform; height equal to two-thirds the greatest transverse diameter of the base; composed of four and a half to five volutions, which are closely coiled, so as to rest nearly upon the surface of the succeeding ones; four of the volutions obliquely compressed on the outer upper portion, and sharply rounded on the periphery and below, giving a somewhat convex trochiform aspect to the coils. Umbilicus broad and deep, exposing more than one-half of each of the preceding whorls, which are strongly rounded and full. Transverse section of the volution obliquely and irregularly ovate, narrow, and somewhat pointed at the upper end at the junction of the volutions, rounded on the inner, and obliquely flattened or depressed-convex on the outer surface.

Surface of the shell marked only by very fine transverse lines of growth, which have a slightly backward curvature as they cross the volution.

This species has something of the form and general appearance of *S. umbilicus* M. & W., from the Coal-Measures (see Geol. Rept. Ills., vol. ii, pl. 27, fig. 1), but is more depressed and proportionally broader, without the horizontal flattening on the upper surface of the volutions, which are instead obliquely compressed nearly in the direction of the slope of the spire.

Formation and locality.—In limestones of the age of the Waverly group, at Dry Cañon, Oquirrh Mountains, Utah. Collected by J. E. Clayton.

CRUSTACEA.

Genus PROETUS Stein.

PROETUS PEROCCIDENS n. sp.

Plate IV, figs. 28-32.

One of the most persistent and characteristic fossils of this formation at the several localities where it has been recognized, and one that will probably serve to identify it at other localities, owing to its marked features, is a small species of Trilobite of the genus *Proetus*. Although specimens of the pygidium have been obtained at all the localities yet recognized, no other parts of the animal have been noticed except from one locality. These were collected, and sent, among other species, by J. E. Clayton, esq., of Salt Lake City, from Dry Cañon, Oquirrh Mountains, Utah. They consist of some detached and imperfect examples of the glabella and cheeks; and as there are no other forms of Trilobites yet known from the locality, and these occurring in the same blocks with the pygidia, it is reasonable to infer that they belong to the same species.

The glabella is conico-cylindrical in form, once and a half as long as wide, very gently narrowing from the base forward, and rounded-truncate in front; very depressed-convex throughout, and marked by four pairs of transverse furrows; the posterior ones strongest, curving backward at their inner ends, nearly surrounding the posterior lobes, forming rounded convex tubercles, each of which is equal in width to one-third that of the entire glabella. The other three pairs are faintly marked, and reach nearly one-third across the glabella; the anterior one transverse and very obscure, distant from the anterior end of the glabella, equal to its width at the furrow; second and third pairs distinct, slightly curving backward at their ends. Occipital ring narrow, depressed-convex, and not strongly marked. Fixed cheeks narrow; palpebral lobe small, situated a little more than one-third of the distance from the posterior border of the head, angular in outline. Frontal border thickened and rounded, well defined, but not distinctly separated from the glabella in front. Posterior lateral limbs not preserved, but narrow at their junction with the fixed cheeks. Suture-line cutting the frontal margin, with a slight curvature at a point distant from the sides of

the glabella equal to one-half its width at the anterior end, and rounding inward with a gentle curvature to the anterior side of the palpebral lobe, the cheek being very narrow at this point, thence passing along the top of the eye to the junction of the posterior lateral limb. Surface of the glabella and cheeks smooth, except a few granules near the base of the glabella.

Movable cheeks of medium size in proportion to the glabella, flattened convex from the base of the eye to the narrow, thickened, and chamfered marginal rim; occipital furrow narrow, not strongly marked, and reaching nearly to the depression within the marginal rim; posterior angles of the cheeks extending backward in the form of short angular spines.

Thoracic segments unknown.

Pygidium paraboloid in outline, highly convex, abruptly so at the sides and posteriorly. Axial lobe forming a little less than one-third of the entire width, and reaching nearly to the posterior margin; rounded and strongly elevated throughout; gradually tapering posteriorly and narrowly rounded at the extremity; marked by from fifteen to seventeen annulations in different individuals exclusive of the anterior articulating ring. Lateral lobes well marked, very convex, slightly flattened near the axis, but very abrupt at the sides and behind; marked by from fourteen to sixteen very sharply elevated angular ribs, which occupy the entire border, extending beyond the end of the axial lobe, and reaching almost to the margin, leaving only a narrow plain space at the edge. The surface of the annulations is marked by a series of small nodes, or pustules, along their crests, arranged in four longitudinal rows on the axial rings, and an indefinite number, closely arranged, occur on those of the lateral lobes.

The species in some of its features resembles *P. macrocephalus* Hall of the shales of the Hamilton group of New York, especially in the markings of the pygidium; but it differs in the more elongate form and number of ribs of this part, while the glabella is proportionally narrower and the sides more nearly parallel; the fixed cheeks and anterior border are narrower, and the movable cheeks terminate in spines, which is not the case with that one. The surface of the glabella and head is also destitute of the strong pustules which characterize that species.

Formation and locality.—In limestones of the age of the Waverly group of the Mississippi Valley, at Ogden and Logan Cañons, Wahsatch Range, and Dry Cañon, Oquirrh Mountains, Utah. Collected by S. F. Emmons and J. E. Clayton.

PROETUS LOGANENSIS n. sp.

Plate IV, fig. 33.

The pygidium of a small species differing very materially from the preceding occurs at Logan Cañon, associated with that one. The form is more nearly semicircular, being but very slightly paraboloid. The axial lobe is highly convex, rapidly tapering below and terminating abruptly a little within the posterior margin; anterior end forming fully one-third of the entire width of the shield. Lateral lobes moderately convex, with a slightly thickened, scarcely elevated border of moderate width, on which the ribs become nearly obsolete. Axial lobe marked by nine rounded and distinct annulations, exclusive of the terminal ones; strong in front and rapidly decreasing in size posteriorly. The ribs of the lateral lobes are ten in number on each side; simple, highly rounded, and continuing entirely around the posterior margin of the shield, the most posterior ones being very faintly marked.

This species differs conspicuously from the corresponding parts of *P. peroccidens* in its shorter form, small number of ribs, and in being destitute of the surface ornamentation which characterizes that one.

Formation and locality.—In limestones of the age of the Waverly group, at Logan Cañon, Wahsatch Range, Utah. Collected by S. F. Emmons, esq.

FOSSILS OF THE LOWER CARBONIFEROUS.

BRACHIOPODA.

Genus ORTHIS Dalman.

ORTHIS RESUPINATA ?.

Plate 5, figs. 1-2.

Orthis resupinata Martin sp.

Shell of moderate size, transversely elliptical or quadrate-elliptical; valves ventricose, the dorsal quite rounded and almost evenly ventricose, sometimes a little fuller on the umbone; middle of the valve slightly impressed with a broad, shallow, mesial sinus, extending from near the beak to the front of the valve; beak proportionally large and full, somewhat incurved, and projecting beyond the line of the hinge; area moderately large, extending about half the length of the valve, the plane of its surface nearly in the direction of the plane of the valve. Muscular impression large, extending to about two-fifths of the length of the shell, distinctly flabellate and lobed. Ventral valve unknown. Surface marked by moderately strong, rounded, radiating striæ and concentric lines of growth.

The species is represented in the collection only by dorsal valves, but the specific characters are unmistakable and easily recognized.

Formation and locality.—In Lower Carboniferous limestone, near the base of the formation, at Dry Cañon, Oquirrh Mountains, Utah. Collected by J. E. Clayton.

Genus PRODUCTUS Sowerby.

PRODUCTUS FLEMINGI var. BURLINGTONENSIS Hall.

Plate 5, figs. 9-12.

Productus Flemingi var. *Burlingtonensis* Hall, Geol. Rept. Iowa, vol. i, part ii, p. 598, pl. 12, fig. 3.

Shell of medium size, wider than long; height and length subequal, or a little longer than high, except in old individuals, where the front is much produced, giving additional height; hinge-line as wide, or a little less than the width of the shell below. Ventral valve strongly arcuate, more abruptly curving just posterior to the middle of the valve; auriculations distinct when

well preserved, and in some cases strongly separated from the body of the valve; sides of the valve a little straightened; front rounded on the lateral portions, but strongly emarginate in the center by the rather strong, sometimes abruptly depressed, mesial sinus, which extends from near the beak to the front of the shell; beak moderately strong, extending beyond the hinge-line and incurved. Dorsal valve nearly flat over the central area, with a slight concavity in the region of the beak, the margins abruptly geniculated to conform to the curvature of the opposite valve. The mesial constriction is as strongly marked, but a little wider than that of the ventral valve, and extends nearly to the beak.

Surface of the shell marked by rather even, rounded striæ of moderate strength, except near the front of the shell, where they become indistinctly fasciculate or blended; also, on the rostral half of the shell by numerous, distinct, closely arranged, concentric, undulating wrinkles, but which seldom extend beyond the point of greatest geniculation. A few scattered spines mark the front and sides of the shell, while several stronger ones are observable on the cardinal aurications. On the dorsal valve, the concentric wrinkles are more distinct, and occupy the entire flattened area of the valve, while the radiating striæ are found to be more strongly bifurcating.

The specimens bear a very close resemblance to those from Burlington, Iowa, in their general form and characters. There are a few unimportant differences noticed, but not such as can be considered of specific importance. There is also considerable resemblance to *Prod. mesialis* Hall (Geol. Iowa, p. 636, plate 19, fig. 2); but that shell is much wider in proportion to the length than any of those from the more western locality.

Formation and locality.—In dark-blue limestone of Lower Carboniferous age, north of Snowstorm Hill, Dry Cañon, Oquirrh Mountains, Utah. Collected by J. E. Clayton.

PRODUCTUS LÆVICOSTUS ?.

Plate 5, figs. 7-8.

Productus lævicostus White?, Jour. Bost. Soc. Nat. Hist., 1860, p. 230.

Shell below the medium size, subtriangular in general outline, rapidly increasing in width from the small, narrow, and rather pointed beak to near

the front of the shell, which is broadly rounded and destitute of any mesial depression; hinge-line short, scarcely more than half as wide as the body of the shell. Ventral valve strongly arcuate in the upper part. Dorsal valve unknown.

Surface of the ventral valve covered by very fine, even, rounded, thread-like striæ, seven to eight of which may be counted in the space of an eighth of an inch on the front of the shell, but are much finer near the beak. The striæ have been marked by numerous fine, slender spines, the bases of which can be seen protruding through a portion of shale adhering to the surface of one of the specimens; but they are so fine as to make scarcely any perceptible scar on the surface of the striæ when denuded.

The species is of the general form of many of those usually referred to *P. Prattenanus* Norwood, but differs materially from the original specimen used and figured by Dr. Norwood in the finer striæ and short hinge-line. It does not appear to be positively identical with any of the forms figured by De Koninck as *P. Cora*, but is a very closely representative species.*

Formation and locality.—In limestone in the higher parts of the Lower Carboniferous, north of Snowstorm Hill, Dry Cañon, Oquirrh Mountains, Utah. Collected by J. E. Clayton.

PRODUCTUS SEMIRETICULATUS Martin.

Plate 5, figs. 5-6.

The specimens of this species in the collection have very much the form and characters of those of the species which occur in the Burlington and Keokuk beds in Iowa and Illinois, represented by the specimen figured in the Geological Report of Iowa (vol. i, part 2, plate 19, fig. 4), except that they are only about two-thirds as large as that individual. The shell is rather narrow and strongly arcuate; the beak narrow and rather pointed, and distinctly separated from the body of the shell; the hinge-line appears to have been about equal in length to the width of the shell below; the sides of the shell abrupt, flattened, and squarish, while the middle of the

* The original specimen of *P. lævicostus* is from the base of the Lower Carboniferous, and from the beds at Burlington, Iowa, referred to the Waverly group; but there are forms of very similar character in other beds of the formations at other places that cannot be readily distinguished from those above referred to.

valve is marked by a rather distinct depression, extending from near the beak to the front of the shell, but most marked on the middle of the valve. The striæ are rather coarse, somewhat irregular, and present a rugose, knotty appearance; while the upper half of the shell is very distinctly marked by strong, irregular, concentric wrinkles, a little less marked in the central depression. A few of the transverse wrinkles are seen marking the front half of the shell in one specimen, and are broad and less deep than those above.

The specimens are proportionally longer and narrower than the typical forms of *P. semireticulatus*; but the form is such a variable one that it is somewhat difficult to define the limits of its characters.

Formation and locality.—In the limestone of Lower Carboniferous age, north of Snowstorm Hill, Dry Cañon, Oquirrh Mountains, Utah. Collected by J. E. Clayton.

PRODUCTUS ELEGANS.

Plate 5, figs. 3-4.

Compare *Productus elegans* N. & P., Jour. Acad. Nat. Sci. Phila., iii, p. 11, fig. 7.

There are two specimens of a *Productus* associated with the preceding, having so much the form and characters of *P. elegans* N. & P., that, unless from a larger number of individuals other and different features shall be obtained, cannot well be considered as distinct from that one. The form is narrow in the upper part, the hinge-line shorter than the width of the shell below; beak rather small and appressed; auriculations not very marked; ventral valve sharply arcuate above and gently curving throughout, with a slight, scarcely defined depression extending from beak to base. Surface of the valve marked by moderately fine but distinctly radiating striæ, which, on the better preserved specimen, have an irregular, knotty appearance, caused by the thickening of the striæ at the spine-bases. The radiating striæ are marked by very fine transverse lines of growth on the forward part of the shell, and on the upper part of the beak and sides of the shell a few obscure transverse wrinkles may be detected.

There are some slight differences between the specimens, one of them being a little more compressed, giving it a broader form, while the striæ are

a little finer and more even than on the other ; but the differences are even less than occur among specimens of *P. elegans* from the typical locality.

Formation and locality.—In limestone of Lower Carboniferous age, north of Snowstorm Hill, near Dry Cañon, Oquirrh Mountains, Utah. Collected by J. E. Clayton.

Genus SPIRIFERA Sowerby.

SPIRIFERA STRIATA.

Plate V, figs. 13-15.

Anomites striatus Martin; *Spirifer striatus* Sowerby and others.

Shell rather above the medium size, transversely oval or semi-elliptical, the hinge-extremities either rounded or slightly extended beyond the width of the shell below. Valves moderately convex, or in some cases rather strongly rounded; the ventral valve most rotund and marked by a broad mesial depression, the margins of which are not strongly defined; front of the valve in the depression somewhat extended and bent upward; beak small, pointed, and closely incurved; area small, poorly defined, the margins rounding to the body of the shell. Dorsal valve most ventricose in the upper part; the sides gradually sloping to the margins, and the center strongly elevated, forming a distinct, sharply rounded mesial fold, which is narrow in the upper part but expands very rapidly as it approaches the front of the shell.

Surface of the valves marked by moderately strong, radiating plications, which are distinct and subangular on the upper part of the shell, but frequently bifurcate and become flattened toward the margin, often forming fascicles of three, four, or more on the extension of the valves, while those near the middle are usually in pairs, but not uncommonly simple.

The species is extremely variable in form and surface-markings as it occurs in the collections examined, representing two quite distinct types, which appear to characterize two different horizons of the geological section of the district in which they were found. Although these differences are easily detected on close examination, still they are not sufficiently strong and marked to be considered as of specific or even varietal importance, and, in their extremes, are not nearly so great as those ascribed to the species

by European authors. The specimens from the lowest horizon are generally more extended on the hinge-line, and sometimes quite elongated; while those from the lower beds are seldom much longer than the width of the shell below, and in some stages of growth appear to have been short and rounded at the cardinal extremities. There is also a perceptible difference in the character of the striæ; those from the higher beds being more finely marked, more angular, and more distinctly fasciculate than the others.

Formation and locality.—In limestone of the Lower Carboniferous age, near the base of the section, at Dry Cañon, and in the higher beds at Snow-storm Hill, Oquirrh Mountains, Utah. Collected by J. E. Clayton.

SPIRIFERA SETIGERA.

Plate 5, figs. 17-18.

Spirifer setigeras Hall, Geol. Rept. Iowa, vol. 1, pt. 2, p. 705, pl. 27, fig. 4.

Shell rather below the medium size, transversely oval or elliptical, with ventricose valves, and a short, scarcely defined hinge-line and rounded extremities. Ventral valve more ventricose than the dorsal, most strongly arcuate in the upper part; beak small, somewhat pointed and strongly or closely incurved; area small, the margins not distinctly defined, but rounded almost imperceptibly into the general curvature of the valve. Center of the valve marked by a moderately distinct, but narrow mesial depression, traceable from beak to base. Dorsal valve rather gently and evenly convex, the center elevated in a narrow, not distinctly defined, rounded elevation corresponding to the depression of the opposite valve.

Surface of the shell marked by numerous, rather closely-arranged concentric varices, marking stages of growth at irregular distances, and also by fine, closely-arranged, setose, radiating lines, most distinct just below each concentric line, but becoming indistinct before reaching the next one below. These lines on the natural surface have been elevated and rounded, forming spines at the concentric ridges, but on the exfoliated surface have the appearance of interrupted radiating lines, scarcely raised on the surface of the shell.

The specimen figured is somewhat imperfect and much distorted by

compression, but the features of the species are so well and distinctly represented on it that it is impossible to doubt its identity.

Formation and locality.—In limestone of Lower Carboniferous age, north of Snowstorm Hill, Dry Cañon, Oquirrh Mountains, Utah. Collected by J. E. Clayton.

SPIRIFERA ——— sp. ?.

Plate 5, fig. 16.

Compare *Spirifera imbrex* Hall, Geol. Iowa, vol. 1, pt. ii, p. 601, pl. 13, fig. 2.

The figure is of a fragment of a cast of the ventral valve in chert, from a fragment of the Weber quartzite, a rock usually destitute of all organic remains, and it is for this reason only that the specimen has been figured. It is of a species possessing numerous sharply-elevated, angular plications, simple on the sides of the shell, and apparently bifurcating in the mesial sinus; although the example does not furnish positive evidence of such bifurcations, still the direction and number would indicate such to be the case. The plications have been crossed by closely-arranged, strong, zigzag, concentric lines; which give a strongly roughened surface to the cast. The only species having strong affinities with it is *S. imbrex* Hall from the Burlington limestone of the Lower Carboniferous formations, at Burlington, Iowa (Iowa Geol. Rept., vol. 1, pt. ii, p. 601, pl. 13, fig. 2), and it is even probable that it may be identical; but, as the ventral valve of that species is unknown to us, we are unable to determine positively. The plications of that species often bifurcate on the upper part of the shell, while these are simple; but this feature may not hold good on all specimens of the same species where the bifurcations are but few.

Formation and locality.—In the Weber quartzite, Bear River, Uinta Range, Utah. Collected by Clarence King, esq.

Genus ATHYRIS McCoy.

ATHYRIS SUBQUADRATA ?.

Plate 5, figs. 19-20.

Athyris subquadrata Hall, Geol. Iowa, vol. 1, pt. ii, p. 703, pl. 27, fig. 2.

Shell of medium size, varying from irregularly circular to distinctly quadrate in outline, with more or less ventricose valves; length usually

somewhat exceeding the width, though often less; point of greatest width a little below the middle of the shell, the margins nearly straight from this point to the beak above and to the front below, giving the quadrangular outline. Dorsal valve ventricose, more distinctly elevated along the middle, forming the proportionally narrow mesial fold, which is often more sharply elevated and sometimes prolonged in front. Ventral valve marked along the center with a narrow depression, corresponding to the fold on the dorsal valve, but narrower, abruptly marked, and extending nearly to the beak; body of the valve ventricose, especially in the upper half; beak strong, sharply incurved, and slightly truncate.

Surface of the valves marked by strong concentric lines of growth at unequal distances, most numerous and crowded near the margin of the shell.

The specimens examined are all more or less imperfect from exfoliation; consequently, the true surface-features cannot be ascertained. The species, however, closely resembles specimens of *A. subquadrata* from the Chester limestones of Illinois and Kentucky, differing mostly in the less distinctly marked and narrower mesial depression of the ventral and corresponding fold of the dorsal valve. The front is also sometimes much produced, but not more so than is often the case with those. The species as found at Chester, Illinois, and elsewhere, is quite variable, and among twenty or thirty individuals from the typical localities specimens could be selected that would correspond in form to any of those presented in this collection.

Formation and locality.—In dark-colored limestone of Lower Carboniferous age; the Wahsatch limestone, at Snowstorm Hill, near Dry Cañon, Oquirrh Mountains, Utah. Collected by J. E. Clayton, of Salt Lake City.

FOSSILS OF THE COAL-MEASURES AND PERMO-CARBONIFEROUS.

LAMELLIBRANCHIATA.

Genus AVICULOPECTEN McCoy.

AVICULOPECTEN WEBERENSIS n. sp.

Plate VI, fig. 5.

Shell of medium size or smaller, suborbicular in outline, the length and height being subequal, anterior side of the shell larger than the posterior, giving a slight obliquity to the valves; hinge-line straight, nearly two-thirds as long as the greatest length of the shell, anterior portion forming rather more than one-third of the length. Left valve very convex, the depth equal to about one-third the height when not compressed. Auriculations not distinctly limited, anterior one small, with a shallow rounded sinus below, extremity rounded; posterior side of moderate size, the sinus faintly marked; extremity obtusely angular.

Surface marked by somewhat irregular radiating costæ, which vary much in size, some of them being moderately strong and distant, with from one to four smaller ones between, most prominent and distinct on the median portion of the valve, becoming gradually smaller on the sides and wings. There are also fine concentric striæ crossing the radii, giving a slightly roughened surface. Right valve unknown.

The species resembles in some of its characters many of those referred to *Eumicrotis Hawni* M. & H., but differs in the size and form of the wings and in the finer radii of the surface. The character of the auriculations would prevent it from being classed as *Eumicrotis*.

Formation and locality.—In limestones of the Upper Coal-Measures (Permo-Carboniferous), foot-hills southeast of Salt Lake City, Wahsatch Range, Utah. Collected by S. F. Emmons, esq.

AVICULOPECTEN CURTO-CARDINALIS n. sp.

Plate VI, fig. 4.

Shell of small size, broadly ovate in outline, and nearly equilateral, widest just below the middle of the height; hinge-line short, not exceeding

half the width of the shell below, and sloping somewhat rapidly from the center to the extremities on each side of the beak. Left valve highly convex, becoming almost subangular on the umbone; auriculations subequal, quite small and indistinctly separated from the body of the shell by very slight, rounded depressions, extending from the beak to the margin on each side, in which they cause slight sinuosities, the anterior one most distinct. Beak small, somewhat pointed, and slightly projecting beyond the cardinal line. Surface of the valve marked by fine, even, rounded, thread-like radiating striæ, scarcely visible without the aid of a lens; also by finer concentric lines. Right valve not observed.

The species presents much the appearance of many forms of *Lima*, and it is possible it should be so referred; but there is no other evidence of a cardinal area on the left valve than the sloping of the hinge-line, while the wings and sinuosities are more like those of *Aviculopecten*.

We know of no species so closely related to this one as to be readily mistaken.

Formation and locality.—In limestone of the Upper Coal-Measures (Permo-Carboniferous), foot-hills southeast of Salt Lake City, Wahsatch Range, Utah. S. F. Emmons, collector.

AVICULOPECTEN PARVULUS n. sp.

Plate VI, fig. 6.

Shell quite small, equilateral, broadly ovate in outline, a little higher than wide; sides and base rounded, slightly prolonged on the postero-basal side, and obscurely angular near the middle of the anterior margin. Hinge-line two-thirds as long as the greatest width of the shell, longest on the anterior side, and very moderately sloping from the beak. Left valve highly convex; wings moderate, not distinctly separated from the body of the shell; anterior one largest, the margins nearly rectangular to each other, the sinus scarcely perceptible, forming only a broadly-curved indentation below the angle; posterior wing small, the margins forming an obtuse angle. Surface of the valve highly convex; beak small and obtusely pointed, barely projecting beyond the cardinal line. Body of the valve marked by alternating larger and smaller radii, the stronger ones extending

to the beak, while the smaller are added at irregular distances; wings marked by finer radii of nearly equal strength. A few irregular concentric undulations cross the radii at unequal distances. Right valve unknown.

This species differs from the preceding (*A. curtocardinalis*) in the stronger radii, in being higher in proportion to the width, and in the longer hinge-line. It differs from *A. occidarius* Meek, plate 12, fig. 13, of his report, with which it is associated, in being a smaller shell, more highly convex, and in having a greater number of strong radii, with a smaller number of intermediate ones; this having usually but one instead of from two to four, as in that species.

Formation and locality.—In limestone of the Upper Coal-Measures (Permo-Carboniferous), foot-hills southeast of Salt Lake City, Wahsatch Range, Utah. Collected by S. F. Emmons, esq.

Genus MYALINA De Koninck.

MYALINA AVICULOIDES.

Plate VI, fig. 8.

Myalina aviculoides M. & H., Proc. Acad. N. Sci. Phil., May, 1860, p. 184; Pal. Up. Mo., p. 51, pl. 2, fig. 8.

Shell of rather more than average size, mytiliform, ovate or triangularly ovate in outline, half as high again as long; beak prolonged, narrow, and somewhat curved; body of the shell nearly erect, highly convex, and obtusely angular along the umbonal ridge, which is placed near the anterior border and parallel to it; anterior face of the shell nearly vertical; posterior surface rapidly and regularly sloping from the crest of the ridge to the posterior margin; hinge-line nearly as long as the shell below the prolongation of the beak; anterior border sinuous above and nearly rectangular to the hinge-line below; base narrowly rounded; posterior margin broadly rounded. Surface marked by rather strong, concentric lines, indicating stages of growth.

The shell is somewhat peculiar for the form of the beak, which is slender and greatly prolonged anteriorly beyond the body of the shell, with a slightly upward curvature near the point. It is also remarkable for the great convexity of the valves along the umbonal ridge, which gives an almost vertical anterior face. These features readily distinguish this from all other species.

Formation and locality.—In limestones of Permo-Carboniferous age, foothills southeast of Salt Lake City, Wahsatch Range, Utah. Collected by S. F. Emmons, esq.

MYALINA PERMIANA.

Plate VI, fig. 7.

Mytilus (Myalina) Permianus Swallow, Trans. St. Louis Acad. Sci., vol. 1, 1858, p. 17.

Mytilus (Myalina) concavus (Swal.) Meek, ib., p. 18.

Myalina Permianus (Swal.) Meek, Pal. Missouri, p. 52, pl. ii, fig. 7.

Shell of medium size, elongate triangularly-ovate, much higher than long, suberect; hinge-line shorter than the width of the shell below; anterior margin concave; base sharply and narrowly rounded; posterior margin broadly rounded, sloping abruptly forward in the upper part to meet the hinge-line, considerably contracting the length of the shell at this point. Surface of the valves highly convex near the front border, and somewhat gradually sloping toward the posterior margin; umbonal ridge rounded; beaks obtuse, nearly or quite terminal. Surface of the shell marked by concentric lines of growth, obscurely preserved on the casts.

This species differs from the last (*M. aviculoides*), with which it is associated, in the less convexity of the valves and more rounded umbonal ridge, as well as in wanting the narrow and prolonged beak of that species. The example used and figured differs from those figured by Mr. Meek (*loc. cit.*) only in having the hinge-line a little shorter. This feature, however, varies much among the specimens in the collection.

Formation and locality.—Occurs with the preceding.

Genus SEDGEWICKIA McCoy.

SEDGEWICKIA ? CONCAVA.

Plate VI, fig. 3.

Sedgewickia ? concava Meek & Hayden, Pal. Up. Missouri, p. 41, pl. 1, fig. 8, 1864.

Lyonsia concava M. & H., Trans. Albany Inst., vol. iv, March, 1858.

Among specimens on a yellowish-brown sandy shale from the Wahsatch Mountains, near Salt Lake City, is one so nearly resembling the figure cited above that we cannot hesitate in considering it as specifically identical. The specimen is about one-third longer than the figure cited, being about nine-tenths of an inch long. The form is transversely elongate-elliptical,

a little more than twice as long as high, with the posterior extremity rounded and recurved; beak large, prominent, and situated at about the anterior third of the length; anterior end rounded, and longest below the middle; basal line slightly convex, more abruptly directed upward for the posterior third of its length; cardinal line concave; valve convex, becoming slightly more compressed posteriorly; marked by slight concentric undulations of growth parallel with the margins.

Formation and locality.—Upper Coal-Measures (Permo-Carboniferous), foot-hills, southeast of Salt Lake City, Wahsatch Range, Utah. Collected by S. F. Emmons.

Genus CARDIOMORPHA De Koninck.

CARDIOMORPHA MISSOURIENSIS.

Plate VI, figs. 1-2.

Cardiomorpha Missouriensis Swallow, Trans. Acad. Sci. St. Louis, vol. 1, p. 207, 1858.

Shell rather below the medium size, transversely elongate and sub-quadrangular in general outline; valves ventricose, or even gibbous, presenting an almost cylindrical form. Hinge-line more than half the length of the shell, very slightly arcuate and abruptly rounding into the posterior extremity, which is obliquely rounded, and longest below; basal margin nearly straight in the middle, curving more abruptly at each extremity; anterior end short, rounded; beaks tumid and enrolled, situated rather within the anterior third of the length; umbonal prominence faintly sub-angular; cardinal slope narrow and abrupt. Surface of the shell marked with fine concentric striæ of growth and stronger undulations. Substance of the shell very thin.

The specimens described differ so little from examples of the species received from the Coal-Measures of Canton, Illinois, that they are not readily distinguished when placed together; the most marked difference being the slightly greater length of the anterior end, and somewhat more prominent beaks. The shell is also a little more excavated in front of the beaks; but these differences are not strong enough to be deemed of specific importance.

Formation and locality.—In black shale of Coal-Measure age, near Eberhardt Mills, White Pine. Collection of Arnold Hague, esq.

CEPHALOPODA.

Genus CYRTOCERAS Goldf.

CYRTOCERAS CESSATOR n. sp.

Plate VI, fig. 15.

Shell of rather small size, moderately curving throughout its length, and rapidly expanding from below upward; the specimen measured showing an increase of diameter from less than half an inch to about eight-tenths of an inch in a length of only about nine-tenths of one inch; section circular. Surface marked by strong, rather distant, rounded annulations, which are separated by concave interspaces. The annulations are directed slightly upward or forward in crossing the back of the shell, and become gradually more distant with the increased growth of the individual; four of these annulations occupy a length of the shell equal to its diameter at the uppermost of those counted. Septa equal in number to the annulations, their extreme outer margins reaching nearly to the crest of the ridges in some cases; others are more distant. Siphuncle small, submarginal, situated a little to the right of the dorsal line (perhaps only an accidental feature).

Surface of the shell marked by fine, crowded, thread-like, encircling striæ on both ridges and interspaces.

The species closely resembles in many of its characters that figured by Meek and Worthen (Geol. Ills., vol. ii, plate 24, fig. 3), under the name of *Orthoceras annulato-costatum*, but differs in its circular section, more rapidly expanding tube, and longitudinal curvature. The latter feature, together with the dorsally-situated siphuncle, would place the species under the genus *Cyrtoceras*, and we strongly suspect the Illinois shell will also prove to belong to the same genus when its true characters are ascertained. The *O. Chesterensis* of Swallow (Trans. St. Louis Acad. Nat. Sci., vol. ii, p. 98) is still further removed from this one by its closely-arranged annulations, though it is not stated if it be curved or straight.

Formation and locality.—In black shales of probably Coal-Measure age, near Eberhardt Mill, White Pine, Nevada; associated with *Goniatites Kingii* and *Cardiomorpha Missouriensis*. Collected by Arnold Hague, esq.

Genus GONIATITES De Haan.

GONIATITES KINGII n. sp.

Plate VI, figs. 9-14.

Shell rather below the medium size, subglobose, the length and breadth being about as three to two; composed of from four to six volutions, which are broadly rounded over the dorsum and subangular at the margin of the broad open umbilicus, into which the sides slope abruptly, forming an angle of about forty-five degrees to the axis of the shell. Each volution embraces the preceding one to near the lateral angle, leaving a very narrow surface exposed within the umbilicus. Extreme width of the volution equal to three times the length, measured from the ventral to the dorsal surface, at the center of the volution.

Surface of the shell and umbilicus marked by fine, subequal, transverse lines of growth, often becoming crowded, and forming incipient undulations on the back of the shell. Surface of the internal casts sometimes marked by transverse constrictions, caused by the thickening of the inner surface of the lip at stated periods of growth, as if for the purpose of strengthening its substance. Two of these constrictions occur in the space of one volution, bringing them on opposite sides of the cast. Septa rather closely arranged and deeply lobed. The dorsal lobe is longer than wide, and deeply divided, forming two long, slender, lanceolate branches, with a shorter, truncated, central projection; dorsal saddle broadly conical, rounded above, and slightly inclined toward the dorsal lobe; lateral lobes as long as the dorsal saddle, obconical, pointed at the lower extremity; lateral saddles broader and shorter than the dorsal saddles.

The shell is somewhat remarkable for the great extent of the outer chamber, appearing from fractured individuals to consist of two complete volutions, and in some cases even more. It does not appear to attain a very large size; the largest fragment observed indicating a specimen of not more than two inches in diameter.

The species is of the type of *G. sphericus* Sow., but is less globose and the umbilicus much larger. There are several American species of the type known, as *G. Nolinensis* Cox and *G. globulus* and *G. Iowensis* M. & W. from

the Coal-Measures, but our shell differs from all of them in the proportionate size of the whorls, in the form of the umbilicus, and in the form and disposition of the septa to such an extent as to be not readily mistaken.

Formation and locality.—In black shale of the Coal-Measures, near Eberhardt Mill, White Pine, associated with *Cyrtoceras cessator* and *Cardiomorpha Missouriensis*. Collected by Arnold Hague, esq.

FOSSILS OF THE TRIASSIC FORMATION.

RADIATA.

ECHINODERMATA.

Genus PENTACRINITES Miller.

PENTACRINITES ASTERISCUS?

Plate VI, fig. 16.

? *Pentacrinites asteriscus* M. & H., Proc. Acad. N. Sci. Phil., 1858, p. 49; 1860, p. 419; Pal. Up. Missouri, p. 67, pl. 3, fig. 2.

Several specimens of the separated disks of a *Pentacrinites* very similar in character to *P. asteriscus* M. & H., but differing somewhat in form, but more particularly in their larger size, have been noticed among the collections from Dun Glen Pass, Pah-Ute Range. When compared with specimens of that species from localities of Jurassic age, they differ slightly in the more obtuse points of the star, and the filling up of the angles between the points, and also in the broader form of the elliptical figures on the articulating surfaces of the disks. As these features, however, are not constant among any considerable number of specimens of that species, even when found together on the same block, we hesitate to consider them of specific importance. The large size is the most noticeable feature of these specimens, some of which exceed one-fourth of an inch in diameter, while those of that species seldom reach one-fifth of an inch, and are usually much smaller. It is possible that this may prove to be a very distinct form when

more and better material shall have been examined, but at present we hesitate to so consider it.

Formation and locality.—In limestone of supposed Triassic age, associated with *Spiriferina Homfrayi* and *Terebratula Humboldtensis* Gabb., near Dun Glen Pass, Pah-Ute Range, Nevada. Collected by Arnold Hague, esq.

BRACHIOPODA.

Genus SPIRIFERINA D'Orb.

SPIRIFERINA HOMFRAYI ?

Plate VI, fig. 18.

? *Spirifer Homfrayi* Gabb, Geol. Sur. Cal., Pal., vol. 1, p. 35, pl. 6, fig. 38.

It is with considerable hesitation that we refer to the above species some very imperfect fragments in the Dun Glen collections. They consist of two imperfect dorsal valves, and some still more fragmentary ventrals; the latter altogether too imperfect for illustration. The dorsal valves are depressed-convex, with slightly rounded cardinal extremities; the mesial fold is simple, broad, and rounded, the front forming a little more than one-fourth of the entire width of the valve, measured along the hinge-line. The sides of the shell are each marked by seven or eight simple, scarcely angular plications, rapidly decreasing in size from the middle outward; front margin nearly semicircular in outline. The ventral valve has been erect and pointed at the beak; the plications appear more angular than those of the dorsal, and the area of considerable height.

The specimens are badly exfoliated, thus rendering the surface-characters obscure. The texture of the shell cannot be distinctly made out, but appears to have been punctate, and for this reason we have classed it under the genus *Spiriferina*, although it may possibly not be properly referred.

Formation and locality.—In dark-colored limestone of Triassic age, one and a half miles south of Dun Glen Pass, Pah-Ute Range, Nevada. Collected by Arnold Hague, esq.

SPIRIFERA (SPIRIFERINA ?) ALIA n. sp.

Plate VI, fig. 17.

Shell of medium size, transversely broad-ovate; the width about one-

sixth greater than the length, measuring on the ventral valve. Valves rotund, with rounded hinge-extremities. Beak of the ventral valve obtuse, incurved, and rounded; area of only moderate height; middle of the valve marked by a well-defined mesial depression, the front of which is equal to more than one-third of the entire width of the valve. Dorsal valve not observed. Surface marked by numerous, rather fine, slightly angular, radiating costæ, which do not appear to bifurcate except on the mesial fold. There are eight plications marking the mesial sinus, near the front margin, on the specimen figured, and about twenty may be counted on each side of the valve. Interior unknown.

We know of no species of *Spirifera* or *Spiriferina* in rock of this age resembling the one under consideration or with which it can be confounded. The substance of the shell, like all those from the same locality, is badly exfoliated, and has apparently undergone some change, which has to some extent obliterated the natural features, so that we are not able to say definitely if it be punctate or not, consequently are in some doubt in regard to its generic relations.

Formation and locality.—In dark-colored limestone of Triassic age, one and a half miles south of Dun Glen Pass, Pah-Ute Range, Nevada. Collected by Arnold Hague, esq.

Genus TEREBRATULA (Llhwyd.) Brug.

TEREBRATULA HUMBOLDTENSIS.

Plate VI, figs. 22-24.

Terebratula Humboldtensis Gabb, Geol. Survey Cal., Pal., vol. 1, p. 34, plate 6, fig. 35.

Shell of medium size, elongate-oval or ovate, widest above or below the middle in different specimens; front of the shell truncate, marked by a simple fold and sinus on the front margin, or by a double fold on the dorsal, with a sinus between, and corresponding elevation and depression on the ventral side. Ventral valve usually slightly flattened across the middle; beak strong and broad, scarcely incurved, truncated by a rather large perforation; cardinal borders broad, strongly inflected and flattened, so as to form an angularity along the edge of the beak.

Surface of the shell marked by strong, irregular, concentric varices of

growth, but without other visible markings. The substance of the shell appears to have been finely punctate; but, owing to some chemical change, the structure is usually obliterated.

The species is a very variable one, both in general form and in the features of the front margin; sometimes being entirely plain, or having a simple elevation and sinus, or being biplicate on the dorsal side, and apparently triplicate on the ventral. These features seldom mark the young or half-grown shells, and on the older specimens are usually confined to the anterior third of the valves.

Formation and locality.—In limestone of Triassic age, near Dun Glen Pass, Pah-Ute Range, Nevada. Collected by Arnold Hague, esq.

LAMELLIBRANCHIATA.

Genus EDMONDIA De Koninck.

EDMONDIA MYRINA n. sp.

Plate VI, fig. 19.

Shell rather below the medium size, transversely ovate, the length nearly one-third greater than the height exclusive of the beaks. Valves very convex, becoming almost inflated near the anterior end and on the umbones; beaks proportionally large and tumid, situated near the anterior end, and projecting largely above the hinge-line; anterior extremity short and rounded; basal line gently convex; posterior extremity more broadly rounded than the anterior; cardinal line nearly two-thirds the length of the shell and gently curved throughout. Surface marked by obscure lines of growth; interior features not determined.

The specimens consist of internal casts, preserving but fragments of the shell in a highly crystalline condition, and do not reveal the true surface of the shell, nor the exact generic relations of the species.

Formation and locality.—In limestone of Triassic age, at Dun Glen, Pah-Ute Range. Collected by Arnold Hague, esq.

FOSSILS OF THE JURASSIC PERIOD.

BRACHIOPODA.

Genus RHYNCHONELLA Fischer.

RHYNCHONELLA MYRINA n. sp.

Plate VII, figs. 1-5.

Shell of medium size, very broadly ovate, being wider than long; the greatest diameter below the middle, valves depressed-convex, the dorsal much the deepest and nearly evenly convex from beak to base, and also transversely. Ventral valve somewhat unevenly convex, slightly flattened toward the sides, and moderately depressed in front to form the proportionally broad mesial extension; beak rather large, pointed, strongly curved upward, and projecting considerably beyond the dorsal valve.

Surface marked by from thirty-two to thirty-four low, rounded plications, eight to ten of which are elevated on the dorsal valve forward of the middle of the shell, forming the rather wide but only moderately elevated mesial fold and a corresponding number impressed on the ventral valve. Minute surface-structure of the shell finely but evenly marked with concentric lines of growth.

This is a very pretty species, and is characterized by the moderately fine plications of the surface, which are of nearly equal strength on all parts of the shell, those of the mesial elevation being hardly perceptibly larger than those on the sides. The species bears considerable resemblance to *Rhynchonella varians* Schl. of the Inferior Oolite from Whitby, England, but differs in the more evenly convex valves and in the rounded plications, those of that species being slightly angular in the specimens examined.

Formation and locality.—In light-colored limestones of Jurassic age, at Flaming Gorge, Uinta Range, Utah.

RHYNCHONELLA GNATHOPHORA ?.

Plate VII, fig. 6.

Rhynchonella gnathophora Meek ?, Geol. Surv. Cal., Pal., vol. 1, p. 39, pl. 8, fig. 1.

A few individuals referred with doubt to this species occur in the collections from Flaming Gorge. The reference, however, is very unsatis-

factory, and, on examining specimens of that species, appears even more uncertain; still, the differences are not so great as to positively preclude the possibility of specific identification. The individual represented on plate 7, fig. 6, is perhaps as closely related to Meek's species as any one seen, but differs very materially in the strength of the plications on the lateral parts of the shell, there being from two to four on each side more than on the most finely marked individuals referred to that species by its author; the shell is also less rotund and more slender and delicate in habit.

Genus TEREBRATULA (Llhwyd.) Brug.

TEREBRATULA AUGUSTA n. sp.

Plate VII, figs. 7-10.

Shell small, broadly ovate, the widest part being a little below the middle of the length; width of the shell less than the length; valves depressed-convex, the dorsal sometimes nearly flat, but usually two-thirds as convex as the ventral; beak small, minutely perforate, and strongly incurved; cardinal slopes angular; margins of the shell acute. Surface marked by lines of growth without perceptible structure except the very fine punctæ of the shell.

The species of this genus, when of the same general type, are so similar that it is extremely difficult to point out specific differences or institute satisfactory comparisons, and the shells now under consideration belong to a form which is so often repeated, both in this and several other genera, that it would be useless to enter into any discussion of specific characters; therefore we shall rely upon the figures to tell their own story.

Formation and locality.—In limestones referred to the Jurassic, at Shoshone Springs, Augusta Mountains, Nevada.

LAMELLIBRANCHIATA.

Genus OSTREA Linn.

OSTREA ——— sp. ?.

Plate VII, fig. 12.

Compare *O. Engelmanni* Meek, Proc. Acad. Nat. Sci. Phila., 1860, p. 311; Pal. Upper Missouri, p. 73, figs. A and B.

A single example, an impression of an upper valve, found associated with the following species, appears to be entirely distinct. It is a much

larger shell, and possesses all the features of a true *Ostrea*. The form is irregularly ovate in outline, moderately convex, and slightly curving posteriorly; length and breadth about as four to three, the expansion of the valve being most rapid on the posterior side below the middle; posterior border concave in the upper part, and sharply rounded below; anterior border regularly and broadly rounded; adductor muscular scar small, submarginal, situated above the middle of the length; the area embraced above the pallial line being not more than one-fourth as great as that below.

The specimen under consideration was at first supposed to be the young, or a small individual, of *O. Engelmanni* Meek, but there is not the slightest evidence of plications, the shell is proportionally longer, and the muscular imprint proportionally smaller and more nearly submarginal; yet the resemblance to that species is quite strong, and it is possible that in such variable shells such changes may take place in the same species.

Formation and locality.—In rocks of Jurassic age, northwest of Rawlings Station, Wyoming.

Genus GRYPHÆA Lam.

GRYPHÆA CALCEOLA var. NEBRASCENSIS.

Plate VII, fig. 11.

Gryphæa calceola var. *Nebrascensis* M. & H., Proc. Acad. Nat. Sci. Phila., 1861, p. 437; Pal. Upper Missouri, pp. 74–75, pl. 3, fig. 1.

Among the Jurassic fossils of the collection are numbers of a small Oyster-like shell, which we suppose to be identical with many of those referred to the above-named variety of Quenstedt's species *G. calceola*. The specimens are mostly small and of variable form, the prevailing feature being broadly and irregularly reniform, or curved-ovate; more or less truncate at the posterior end; the smaller valve being extremely shallow and scarcely convex, while the attached valves are very irregular and variable in depth and convexity, most of them being flattened and attached over the greater part of their extent, with the edges abruptly curved upward, to give the requisite depth, others scarcely showing any mark of attachment, and still others are squarely and vertically truncate at the upper extremity, similar to those represented in the Pal. Upper Missouri,

pl. 3, figs. 1 *b* and *c*. The most general feature seems to be their small size, although they differ in this respect, for while the majority of the specimens range from half to three-fourths of an inch in length, other examples are found attaining a length of an inch and a half.

It will be seen, by reference to the remarks of Messrs. Meek & Hayden on this species, that they have met with all these various phases and variations among their specimens, although they speak of examples of much larger size, where the attached valves are deep and strongly arcuate, with large, strongly incurved beaks. These they term "normal forms" of the variety, although it would seem that from some of their localities these forms are nearly or quite absent, and that the flattened forms prevail. Among the examples examined by us there are none of these "normal forms", but all are of the irregularly convex, the squarely truncate, or the flattened forms above referred to; and it seems to us that these forms are much more likely to prove an entirely distinct species from the so-called "normal forms" than that they are merely individual differences. In fact, from the specimens before us, and from the figures above referred to, it appears that there is but little reason for considering the forms under consideration as belonging to any other genus than *Ostrea*; while those referred to as "normal forms" are unquestionably true *Gryphæa*.*

In the flattened and almost wholly attached examples, the form and characters are so exactly similar to *Ostrea congesta* Conrad, from the Cretaceous formations, that it is nearly or quite impossible to say wherein they differ, except, perhaps, that they are not so gregarious or so densely packed together as that species often is.

Formation and locality.—In shaly limestone of Jurassic age, at Sheep Creek, Uinta Range, Utah, associated with *Camptonectes bellistriatus*, *Pentacrinites asteriscus*, &c.; and on Ashley Creek, Uinta Range, associated with *Camptonectes? extenuatus*, *Bellemnites densa*, &c. Collected by S. F. Emons, esq.

* Since the above paragraph was written, Dr. C. A. White has described these small shallow forms under the name *Ostrea strigilecula* (see Pal. Rep. Geograph. and Geol. Surv. and Expl. West of 100th Merid., Lieut. Wheeler in charge, by C. A. White, p. 163, pl. xiii, fig. 3).

Genus *AVICULOPECTEN* McCoy.*AVICULOPECTEN* (*EUMICROTIS*?) *AUGUSTENSIS* n. sp.

Plate VII, figs. 14-16.

Shell small, broadly ovate, higher than wide; length of the hinge equal to about half the height of the shell, the anterior side straight and forming two-thirds of the entire length, posterior side slightly declining from the beak; left valve moderately convex, most prominent on the umbone; beak small, obtusely pointed and but slightly projecting beyond the hinge-line; auriculations depressed, but not distinctly separated from the body of the shell, the anterior one of moderate size, posterior one quite small. Surface of the valve marked by simple rounded ribs of equal strength, except on the left auriculation, where they are finer, somewhat corrugated, and strongly curved upward to the margin. Right valve flat or very slightly convex; beak depressed and not extending beyond the hinge-line; ears much more distinctly marked than on the left valve, the lines separating them from the body of the shell, strong, nearly straight, and rapidly diverging from the beak, inclosing an angle of about ninety degrees; anterior auriculation large, rounding inward from the extremity. Byssal notch more than a third as deep as the length of the ear, broad and rounded at the bottom. Surface-markings similar to those of the opposite valve.

The specimens from which the description is taken are slightly exfoliated and do not present the natural surface-markings; but another fragment presenting a weathered surface shows concentric striæ, which are strongly vaulted in crossing the radii, but not distinctly marked in the depressions.

The species has much resemblance, especially the left valve, to many of those referred by Mr. Meek to his genus *Eumicrotis*, in general form and surface-markings, but differs strongly in the large anterior auriculation and byssal notch of the right valve, corresponding in this respect more nearly with *Aviculopecten*, and we are undecided as to which genus they ought properly to be referred.

Formation and locality.—In limestone referred to the Jurassic, Shoshone Springs, Augusta Mountains. Collected by S. F. Emmons, esq.

Genus EUMICROTIS Meek.

EUMICROTIS CURTA.

Plate VII, fig. 24.

Avicula curta Hall, Stans. Rept. Salt Lake, p. 412, pl. 2, fig. 1.*Avicula (Monotis) tenuicostatus* M. & H., Proc. A. N. Sci. Phil., 1858, p. 50.*Monotis curta* M. & H., Proc. A. N. Sci. Phil., 1860, p. 418.*Eumicrotis curta* M. & H., Smithsonian Check-List N. Am. Invert. Foss., 1864.*Eumicrotis curta* M. & H., Pal. Upper Missouri, p. 81, pl. 3, fig. 10.

Shell small, suborbicular or obliquely ovate, a little higher than long, or height and length subequal; valves convex, the left one the most rotund. Hinge-line short, compressed behind and forming a small, obtusely-angular wing; anterior side very short, scarcely forming a wing, the anterior margin rounding nearly to the beak; posterior margin gradually sloping backward from the extremity of the hinge to a point below the middle of the valve, whence it is rather sharply rounded to the junction with the basal line. Base slightly prolonged on the posterior side of the median line, giving a little obliquity to the shell. Right valve apparently less convex than the left. Surface marked by distinct radiating lines or ribs, which are narrower than the spaces between, and usually become obscure or obsolete before reaching the beaks. On the right valve, the radii are much less strongly marked, while the concentric striae become more distinct.

Among a large number of specimens there are no right valves in a condition to show the hinge-features or byssal notch, and we are therefore left somewhat in doubt concerning these features. The shells appear to possess all the essential characters of *E. curta*, but vary so much among themselves as to give rise to some doubt.

Formation and locality.—In calcareous beds of Jurassic age, above the gypsum beds at Ashley Creek, Uinta Range, Utah. Collected by S. F. Emmons, esq.

Genus CAMPTONECTES Agassiz.

CAMPTONECTES BELLISTRIATUS Meek.

Plate VII, fig. 13.

Camptonectes bellistriatus Meek, Pal. Upper Missouri (Smithsonian Contributions to Knowledge), p. 77, figs. A-D.

"Shell very thin, compressed-lenticular, suborbicular in outline; valves

nearly equally convex; hinge-line equaling two-fifths to one-half the transverse diameter of the valves; posterior ear very short, or nearly obsolete, flat, and obliquely truncated; anterior ear larger, flattened, and marked by rather distinct lines of growth in the right valve, separated from the adjacent margin by a more or less angular sinus, one-third to one-half as deep as the length of the ear, measuring from the beak. Surface striae very fine, regular, sharply impressed, and increasing in number by the intercalation of others between as they diverge in extending from the umbonal region, so strongly arched as to run out on the hinge-line near the beaks; concentric striae fine, regular, closely arranged, and often nearly or quite obsolete on the impressed spaces between the impressed radiating striae, to which latter they impart a subpunctate appearance."

The above is a transcript of Mr. Meek's description of this species. Although there are quite a number of specimens in the collection which are referable to it, there are none which give the entire characters of the shell; nor are there any from which a figure could be made without some restoration. Still the characters of the species are, nevertheless, shown so distinctly as to leave no doubt as to the correct reference. The specimens are generally smaller than the figures given by Mr. Meek, and some of them are a little more oblique in outline, while the characters of the surface vary from being nearly smooth to those strongly cancellated; while on some the concentric striae are strongest, and on others nearly obsolete.

Formation and locality.—Jurassic; specimens have been recognized from northwest of Rawlings Station, Wyoming, and from Sheep Creek, and Flaming Gorge, Uinta Range, Utah. Collected by S. F. Emmons, esq.

CAMPTONECTES EXTENUATUS Meek.

Plate VII, fig. 18.

Camptonectes? extenuatus Meek, Pal. Upper Missouri (Smithsonian Contributions to Knowledge), p. 78.

Camptonectes? pertenuis M., ib., pl. iii, explanations of fig. 6.

Shell small, erect, broadly ovate, a little higher than wide, the point of greatest width being near the middle of the shell; hinge-line short, about half as long as the width of the valve; ears small, the anterior one slightly

obtuse at the outer angle, the posterior margin sloping gently backward toward the body of the shell, the posterior wing not fully determined. Body of the (right?) valve convex, most prominent, and almost subangular toward the umbo; beak small, pointed, scarcely projecting beyond the hinge-line; margin of the shell broadly rounded anteriorly and posteriorly, and somewhat acutely rounded at the base.

Surface of the valve in the specimen seen marked by fine, concentric, impressed lines, and by stronger radiating lines. These latter seem to be composed of rows of fine dots, or punctures, and are strongly divergent, so as to curve abruptly upward toward the margin on the sides of the valve, the increase being entirely by interstitial addition.

The shell differs from *C. bellistriata* Meek in its smaller size, convex valves, more erect form, and in the proportional height and width of the valve, this being higher than wide, while the reverse is true of the other.

There can be no doubt that this is the shell to which Mr. Meek gave the above names, although he had not seen the radiating striæ of the surface so plainly as to feel sure of their existence. On the specimen used in the above description, the striæ are very distinct, and have exactly the character of that of *C. bellistriata*; consequently, there can be no doubt of its correct reference to the genus *Camptonectes*, although in our specimens the anterior wing and sinus have not been satisfactorily determined, that part in the figure having to be made from analogy.

Formation and locality.—In light-colored shales of Jurassic age, northwest of Rawlings Station, Wyoming.

CAMPTONECTES PERTENUISTRIATUS n. sp.

Plate VII, fig. 17.

Shell small, very broadly ovate, the point of greatest width being about the middle of the length, width equal to about four-fifths of the height; base and sides of the shell regularly rounded. Right valve very depressed-convex or almost flattened; hinge-line short, the anterior side equal to a little more than one-third of the width of the valve below; posterior side unknown, the specimen being mutilated in this part. Beak small, pointed, not rising above the line of the hinge; cardinal slopes nearly straight from

the beak to a little above the middle of the length, and embracing an angle of about ninety degrees; anterior wing narrow, separated from the body of the shell by a deep, sharply rounded notch, which extends about half-way to the center of the valve; a strongly-depressed sinus passes from the base of the notch to the beak, separating the upper part of the wing from the body of the shell.

Surface of the shell marked by rather distinct, concentric lines of growth, which are crossed by exceedingly fine, radiating striæ, imperceptible except by the aid of a lens. The striæ diverge rapidly from the median line, and curve upward rather more strongly toward the sides of the shell.

The shell differs from *C. ? extenuatus* Meek and Hayden (Pal. Upper Missouri, p. 78, plate iii, fig. 6) in its more attenuated beak, flattened valve, finer striæ, and more elongate form.

Formation and locality.—In limestone of Jurassic age, northwest of Rawlings Station, Wyoming.

Genus LIMA Brug.

LIMA (PLAGIOSTOMA) OCCIDENTALIS n. sp.

Plate VII, fig. 23.

Shell of medium size or smaller, very broadly ovate, the height slightly exceeding the greatest width; widest point about one-third of the height from the basal extremity, below which the margin is regularly and evenly rounded, and above the posterior border is more rapidly rounded and contracted to the extremity of the short hinge-line, with which it blends without perceptible angle. Valves strongly convex, most ventricose near the middle of the anterior border, from which point the surface declines to the postero-cardinal and postero-basal margins; beaks apparently small, inconspicuous, and somewhat appressed (?). Anterior wing minute, posterior wing small, but alated, not distinctly separated from the body of the shell; ligamental area not observed. Anterior border of the shell strongly concave, the concavity extending more than half the height of the shell.

Surface of the shell marked by simple, strong, rounded radii, about sixty in number, posterior to the junction of the anterior and basal borders, with a few incipient radii observable on the anterior slope. The radii are

strongest near the middle of the basal border, and decrease very slightly in size anterior to this point; but posteriorly they decrease more rapidly, and on and near the posterior alation are quite fine. Interspaces narrow and concave.

This species is closely allied to *Lima lineata* Gold. (= *Plagiostoma lineata* of authors,) but differs in being more regularly rounded on the basal and postero-basal borders, as well as in being more erect, that species having considerable obliquity, the longest point of the base being much nearer the anterior side. The beak is also shorter, and not nearly so prominent, and the greatest convexity of the shell nearer the anterior margin, while that one is most prominent near the middle of the valve, and nearly evenly rounded in both directions from this point. The posterior wing of this species is more alate than in that one, and more finely ribbed, giving about fifteen additional ribs over and above the number counted on that species. This character is perhaps the most distinctly marked feature of the species, and one that will serve to readily distinguish them, although the general resemblance of the shells is very great.

Formation and locality.—In cherty limestones of Jurassic age, at Flaming Gorge, Uinta Range, Utah. Collected by S. F. Emmons, esq.

Genus TRIGONIA Brug.

TRIGONIA QUADRANGULARIS n. sp.

Plate VII, fig. 22.

Shell small, subquadrangular in outline, with depressed convex valves and flattened inconspicuous beaks; length of the shell a little greater than the height; anterior end broad and rather squarely truncate; the margin but slightly rounded; basal line somewhat straightened or but slightly convex, more strongly rounded behind; posterior end obliquely truncate, longest below; cardinal border short, not more than two-thirds the length of the valve, very little concave, and subparallel with the basal margin.

Surface of the valve marked by a flattened, distinctly elevated ridge, which rises from behind the beaks, and passes along the umbonal slope, extending beyond the posterior margin of the valve in a squarish projection, equal in extent to the elevation of the ridge. Above the ridge, the

cardinal slope is narrow and depressed, marked only by transverse lines of growth. The surface of the ridge is marked by irregular transverse lines of nodes. The body of the shell is marked by a series of low, rounded ridges or undulations, which originate in a point at the edge of the flattened umbonal ridge, and extend in the direction of the postero-basal angle of the shell, where they are again bent forward, forming a series of acute angles marking the umbonal line of the shell, and are directed with a slightly downward tendency to the anterior margin. Along the umbonal ridge of the valve the undulations are broad and rounded, becoming narrow again in their anterior extension.

The strong undulations of the body of the shell of this species is a distinguishing feature, and one by which it will be readily recognized. It differs greatly in this feature from *T. Conradi* M. and H. (Pal. Upper Missouri, p. 83, pl. 3, fig. 11) from the Jurassic of the Black Hills, as well as in the subquadrangular form of the shell, that species being of a subtriangular form.

Formation and locality.—In light-colored, somewhat shaly, limestones of Jurassic age, near Como, Laramie Plains, Wyoming, associated with *Pentacrinites asteriscus* M. and H. and other Jurassic species. Collected by Arnold Hague, esq.

Genus SEPTOCARDIA n. gen.

Shell bivalve, equivalve, inequilateral, cardiform. Hinge strong; right valve with a strong, recurving, hooked tooth under the beak, and a deep cavity below and exterior to it, which is profoundly excavated in the thickened substance of the shell. In the left valve, a large, deep cavity corresponds to the tooth of the right valve. Lateral teeth obsolete. Ligament external, situated in a groove formed by a thickened, overlapping portion of the shell posterior to the tooth and corresponding cavity. Anterior adductor muscular scar very large and deep, separated from the general cavity of the shell by a calcareous plate, or septum, extending across the anterior end of the valve on the inner side of the scar, thereby forming a distinct chamber in each valve. Posterior adductor scar much smaller, situated within the posterior cardinal margin. Pedal scars not observed.

Surface of the shell marked, in the typical species, by strong, elevated, radiating ribs, with ornamented surfaces similar to many of the recent species of *Cardium*. Type *S. typica*.

The shells for which the above generic name is proposed are small, few specimens of the typical species exceeding three-eighths of an inch in their greatest diameter. Externally they closely resemble the Eocene forms of *Cardita*, but the hinge-structure separates them at once from all other known forms. The cardinal border of the right valve appears almost as if composed of two distinct lamellæ of shell, an inner and an outer one, the inner one originating on the inside of the umbonal cavity, and rising to the level of the valve margin, coalescing with the outer portion posteriorly, and diverging considerably anteriorly, so as to leave a gradually-widening space between the two, the anterior end of which is partitioned off, forming the anterior muscular scar, or pit, and leaving a smaller, somewhat triangular, cavity posterior to it. From the inner lamella bounding this cavity, the recurved, hooked tooth rises, overarching the cavity beneath. In the left valve, the two lamellæ are less distinct; the whole cardinal border being thickened, and the cavity into which the tooth of the right valve fits is excavated in its substance, immediately in front or against the beak of the valve. There are no lateral teeth in either valve. The septum bounding the inner margin of the anterior muscular scar is similar to that of *Cucullæa* or *Idonearca*, except that it borders the anterior instead of the posterior muscle as in those genera, and in the species *S. typica* reaches almost to the basal margin of the valve.

The type-species occurs in rocks referred with some doubt to the Jurassic, although the general appearance of the shells would indicate a much more recent date.

SEPTOCARDIA TYPICA n. sp.

Plate VII, figs. 26-29.

Shell small, subrhomboidal in outline, the united valves angularly cordiform and very gibbous. Valves longer than high, oblique, and widening posteriorly; beaks strong, angularly tumid and enrolled, situated near the anterior end of the shell; cardinal line arcuate, slightly elevated posteri-

orly; anterior end short and obtusely pointed; basal line gently rounded; posterior end broadly truncate and slightly rounded. Body of the valves very ventricose, subangular along the umbonal ridge, marked by strong radiating costæ, separated by equally wide, flattened interspaces; six or eight of these costæ occupy the postero-cardinal slope, and from twelve to sixteen may be counted on the body and anterior portion of the shell. The costæ are flattened on the summit, and marked by closely-arranged, recurved, transverse ridges, or nodes, which become more crowded and stronger with the increased age of the shell. Interior margin of the valves strongly denticulate from the squarely-depressed grooves, corresponding to the external ribs, and which extend to nearly one-third of the width of the shell.

Formation and locality.—In limestones referred to the Jurassic, at Shoshone Springs, Augusta Mountains, Nevada. Collected by S. F. Emmons, esq.

SEPTOCARDIA CARDITOIDEA n. sp.

Plate VII, fig. 25.

Shell of medium size, subrhomboidal in outline, longer than high, narrow anteriorly, and widening behind. Valves ventricose, very angular along the umbonal bridge, rapidly sloping to the postero-cardinal margin, and more gently toward the anterior end of the shell; beaks large, prominent, and strong; placed well toward the anterior end, which is narrowly rounded; basal line broadly rounded; posterior extremity obliquely truncate, longest at the postero-basal angle. Internal features unknown. Surface marked by numerous, strong, sharply-elevated, angular, radiating costæ, with sharply V-shaped interspaces, the exact number not determined; those on the postero-cardinal slope near the basal angle counting about five in the space of half an inch, giving about a tenth of an inch from crest to crest; toward the cardinal line they become gradually finer. Those on the body of the shell appear to have been of nearly equal strength with those on the posterior part, becoming finer toward the anterior extremity. The costæ are crossed transversely by fine, closely-arranged, zigzag lines, strongly arched upward in crossing the ribs. Greatest length of the specimen, $1\frac{3}{4}$ inches; height, $1\frac{1}{8}$ inches.

This species differs from *S. typica* not only in its greater size, but in

being proportionally longer, but most notably in the angular form of the ribs and interspaces, as well as in the different style of transverse ornamentation. The specimen presents much the appearance of an Eocene *Cardita*, and closely resembles *C. alticostata* Conrad (*C. transversa* Lea) of the Claiborne beds in Alabama, except that it is narrower anteriorly.

Formation and locality.—In limestone referred to the Jurassic, Shoshone Springs, Augusta Mountains, Nevada. Collected by S. F. Emmons, esq.

Genus ASTARTE Sowerby.

ASTARTE? ARENOSA n. sp.

Plate VII, figs. 20-21.

Compare *Tancredia Warrenana* Meek and Hayden, Pal. Upper Missouri, p. 96, pl. 3, fig. 7.

Shell small, the largest specimens not exceeding half an inch in length, by a height about two-thirds as great; form transversely suboval, or quadrangularly oval; cardinal line arcuate, but little more than half as long as the body of the shell, gradually and moderately declining posteriorly; anterior end constricted in front of the beaks, and rather sharply rounded below; basal line broadly convex; posterior end narrow and obliquely truncate, being longest below at the junction with the basal border; beaks small, incurved, moderately ventricose, and situated at about one-fourth of the length from the anterior end. Valves ventricose throughout, with a perceptible fullness along the umbonal slope, above which the shell declines more rapidly to the cardinal border. Features of the hinge and muscular system unknown. Surface of the shell smooth, so far as can be determined from the specimens examined.

At first, we were inclined to consider this shell as identical with *Tancredia Warrenana* M. (*loc. cit.*), but on closer comparison with figures and description it would seem to be distinct. At least, it is not a *Tancredia*, and may be equally distant from *Astarte*; but, in the absence of all generic features in the specimens beyond the external form, it is impossible to say definitely to what genus it does belong. It is an abundant species in some localities, the rock being literally filled with the impressions. It differs specifically from the above-named shell in being less distinctly triangular

and in the more anterior position of its beaks, as well as in the want of convexity in the curvature of the antero-cardinal border, as would be required were it a species of *Tancredia*.

Formation and locality.—In red sandstones of Triassic or Jurassic? age, North head of Chalk Creek, Utah. Picked up in the *débris*, and of no stratigraphical importance.

GASTEROPODA.

Genus NATICA Lam.

NATICA? LELIA n. sp.

Plate VII, figs. 19-21.

Shell small, globose; height and width about equal, and seldom exceeding a fifth of an inch in measurement. Volutions two and a half to three, the last one very rapidly expanding and ventricose, constituting almost the entire bulk of the shell; inner volutions minute, moderately elevated above the surface of the body-whorl, and somewhat regularly rounded, forming a very low spire; suture distinct but not channeled; aperture subpatulose or pear-shaped, higher than wide, largest below the middle, pointed at the upper extremity and rounded below, except near the junction with the columella, where it is almost subimate; outer lip thin and sharp. Columella arcuate, rounded, without any appearance of a callus or thickening of any kind as far as can be determined from any of the examples in hand. (This portion of the shell is more or less concealed by adhering rock in all the individuals, so that this feature cannot be satisfactorily determined.) The striæ, however, appear to pass from the body of the shell directly upon and over the solid, slightly-twisted, and non-umbilicated columella.

Surface of the shell smooth, appearing almost polished, except for the very fine striæ of growth which are directed backward across the body of the volution.

The species has nearly the size and general appearance of *Naticopsis nana* Meek and Worthen, from the Coal-Measures of Illinois and the West, but differs in the columella being less straightened and prolonged below, not giving so great a basal extension to the aperture. The differences of the character of the columella are too distinct to require comparison. The

shell is most probably not a true *Natica*, and may possibly not belong to the same family; but as the real features of this portion cannot be satisfactorily determined, it remains a matter of doubt. It closely resembles, in general form, shells of the genus *Neritopsis* except for the smooth surface. It differs also from *Neritoma* Morris in wanting the peculiar callus of that genus and from *Narica* Recl. in the smooth surface and want of umbilicus.

Formation and locality.—In a greenish white limestone supposed to be of Triassic age,* northwest of Rawlings Station, Wyoming, and on the East Fork of the Duchesne River, Uinta Range, Utah. Collected by S. F. Emmons, esq.

*I do not myself believe this to be Triassic, but it has been so referred by others.—R. P. W.

CLASSIFIED LIST OF THE FOSSILS DESCRIBED IN THIS REPORT.

Class.	Order.	Family.	Genus and species.	Formation.
CŒLEENTERATA.				
Actinozoa.....	Zoantharia	Favositidæ	Michelina sp. undet.....	Waverly group.
ANNULOIDA.				
Echinodermata ...	Crinoidea	Pentacrinidæ	Pentacrinites asteriscus? M. & H.....	Triassic.
MOLLUSCOIDA (ARTICULATA?).				
Brachiopoda	Lyopomata	Lingulidæ	Lingulepis Mæra n. sp	Potsdam group.
Do.....	do	do	Lingulepis minuta n. sp.....	do.
Do.....	do	do	Lingulepis Ella n. sp.....	Quebec.
Do.....	do	Obolidæ	Obolella discoida n. sp.....	Potsdam group.
Do.....	(?)	(?)	Kutorgina minutissima n. sp	do.
Do.....	Arthropomata	Orthidæ	Orthis Pogonipensis n. sp.....	Quebec group.
Do.....	do	do	Orthis resupinata? Martin.....	Lower Carbonif.
Do.....	do	Strophomenidæ	Strophomena Nemia n. sp.....	Quebec group.
Do.....	do	do	Strophomena rhomboidalis Wilkins.....	Waverly.
Do.....	do	do.?	Streptorhynchus equivalvis Hall	do.
Do.....	do	do.?	Streptorhynchus inflata W. & W.	do.
Do.....	do	do	Strophodonta Canace H. & W.....	Devonian.
Do.....	do	do	Leptaena Melita n. sp.....	Quebec group.
Do.....	do	Productidæ	Chonetes Loganensis n. sp	Waverly.
Do.....	do	do	Productus Flemingi var. Burlingtonensis Hall	Lower Carbonif.
Do.....	do	do	Productus lævicostus? White.....	do.
Do.....	do	do	Productus semireticulatus Martin	do.
Do.....	do	do	Productus elegans? N. & P.....	do.
Do.....	do	Spiriferidæ	Spirifera Alba-pinensis n. sp.....	Waverly.
Do.....	do	do	Spirifera? (Spiriferina) Alia n. sp	Triassic.
Do.....	do	do	Spirifera centronata Winchell	Waverly.
Do.....	do	do	Spirifera imbrex? Hall.....	Lower Carbonif.
Do.....	do	do	Spirifera setigera Hall	do.
Do.....	do	do	Spirifera striata Martin	do.
Do.....	do	do	Spiriferina? Alia n. sp.....	Triassic.
Do.....	do	do	Spiriferina Homfrayi Gabb.....	do.
Do.....	Lyopomata	Lingulidæ	Athyris Claytoni n. sp.....	Lower Carbonif.
Do.....	do	do	Athyris planosulcata? Phillips.....	do.
Do.....	do	do	Athyris subquadrata? Hall.....	do.
Do.....	do	Rhynchonellidæ	Rhynchonella Emmons n. sp.....	Devonian.
Do.....	do	do	Rhynchonella gnathophora Meek.....	Jurassic.
Do.....	do	do	Rhynchonella Myrina n. sp	do.
Do.....	do	do	Rhynchonella pustulosa? White	Waverly.
Do.....	do	(?)	Porambonites obscurus n. sp	Quebec.
Do.....	do	Terebratulidæ	Terebratula Augustensis n. sp	Jurassic?.
Do.....	do	do	Terebratula Humboldtensis Gabb.....	Triassic.
Do.....	do	do	Terebratula Utah n. sp	Waverly.
MOLLUSCA.				
Lamellibranchiata.	Monomyaria	Ostreidæ	Ostrea sp. ?? = O. Engelmanni Meek	Jurassic.
Do.....	do	do	Gryphæa calceola var. Nebrascensis M. & H.	do.
Do.....	do	Pectinidæ	Aviculopecten (Eumicr.?) Angustensis n. sp.....	do.
Do.....	do	do	Aviculopecten curtocardinalis n. sp	Permo-Carbonif.
Do.....	do	do	Aviculopecten parvulus n. sp	do.
Do.....	do	do	Aviculopecten Weberensis n. sp	do.
Do.....	do	do	Eumicrotis curta Hall.....	Jurassic.

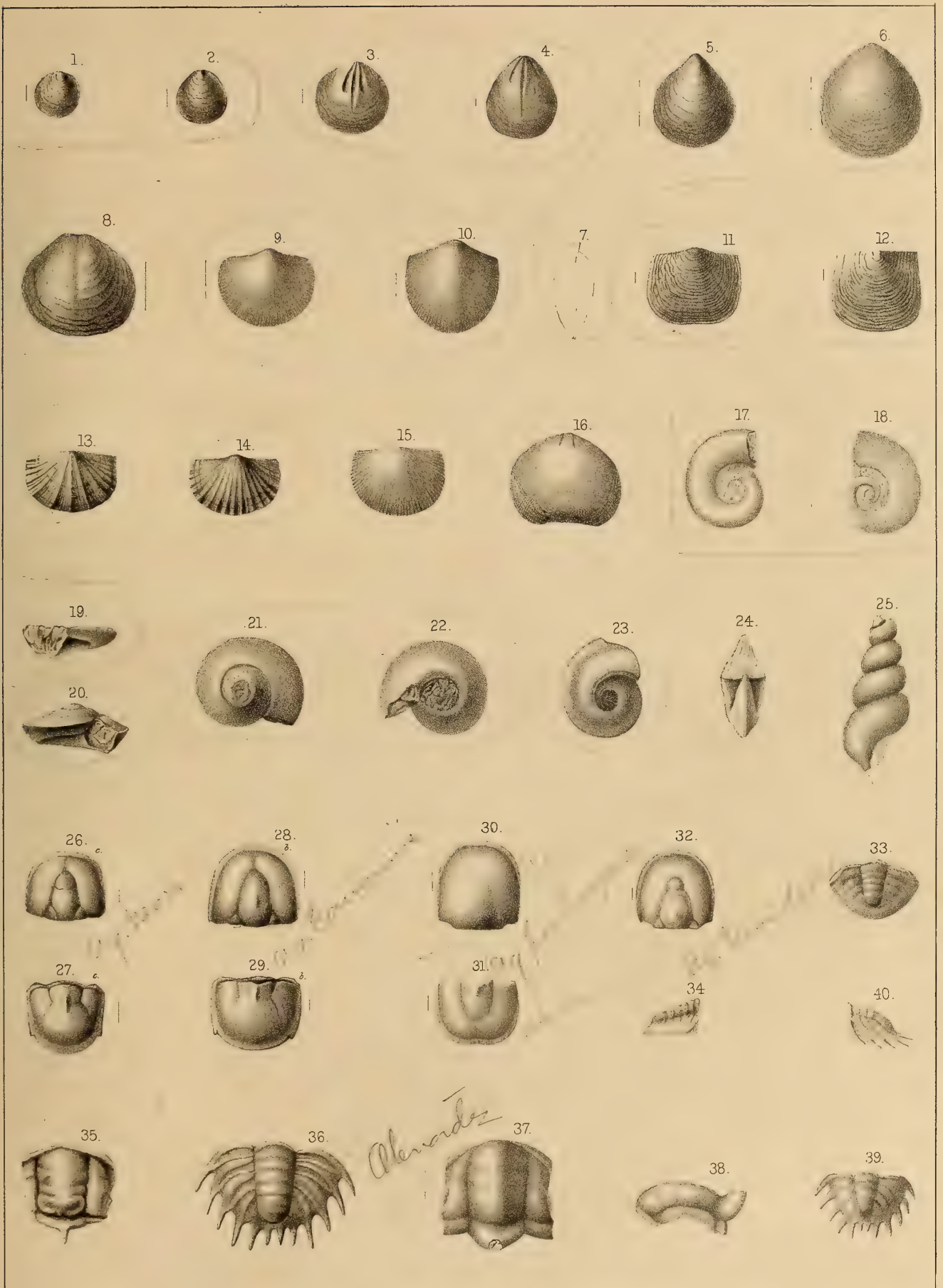
Class.	Order.	Family.	Genus and species.	Formation.
MOLLUSCA.				
Lamellibranchiata.	Monomyaria	Pectinidae	Camptonectes bellistriatus Meek	Jurassic.
Do	do	do	Camptonectes extenuatus M. & H.	do.
Do	do	do	Camptonectes pertenuistriatus n. sp.	do.
Do	do	do	Lima (Plagiostoma) occidentalis n. sp.	do.
Do	do	Pteriidae	Myalina aviculoides M. & H.	Permo-Carbonif.
Do	do	do	Myalina Permiana Swallow.	do.
Do	Dimyaria	Nuculanidae	Nuculites triangulatus n. sp.	Devonian.
Do	do	Trigoniidae	Trigonia quadrangularis n. sp.	Jurassic.
Do	do	Cardiophoridae	Cardiomorpha Missouriensis Swallow.	Coal-Measures.
Do	do	do	Edmondia? Myrina n. sp.	Triassic.
Do	do	Cardiidae	Lunulicardium fragosum Meek	Devonian.
Do	do	do	Septocardia Carditoidea n. sp.	Jurassic?.
Do	do	do	Septocardia typica n. sp.	do.
Do	do	Lucinidae	Paracyclas peroccidens n. sp.	Devonian.
Do	do	Astartidae	Astarte? arenosa n. sp.	Triassic?; loose.
Do	do	Anatinidae?	Sedgewickia? concava Meek	Permo-Carbonif.
Gastropoda	Pectinobranchiata	Fascioliidae	Fusispira compacta n. sp.	Quebec.
Do	do	Naticidae	Natica? Lelia n. sp.	Triassic?.
Do	do	Solariidae	Raphistoma acuta n. sp.	Quebec.
Do	do	do	Euomphalus laxus White	Waverly.
Do	do	do	Euomphalus Utahensis n. sp.	do.
Do	do	do	Euomphalus (Strap.) Ophirensis n. sp.	do.
Do	Rhipidoglossa	Maclureidae	Maclurea minima n. sp.	Quebec.
Do	do	Bellerophonidae	Bellerophon Neleus n. sp.	Devonian.
Do	do	do	Cyrtolites sinuata n. sp.	Quebec.
Cephalopoda	Tetrabranchiata	Cyrtoceratidae	Cyrtoceras cessator n. sp.	Coal-Measures.
Do	do	Goniatitidae	Goniatites Kingii n. sp.	do.
ARTICULATA.				
Crustacea	Trilobita	Calymenidae	Conocephalites subcoronatus n. sp.	Quebec.
Do	do	Calymenidae?	Conoceph. (Pterocephalus) laliceps n. sp.	Potsdam group.
Do	do	Paradoxidae?	Crepicephalus (L.) Anytus n. sp.	do.
Do	do	do	Crepicephalus (L.) granulatus n. sp.	do.
Do	do	do	Crepicephalus (L.) Haguei n. sp.	do.
Do	do	do	Crepicephalus maculosus n. sp.	do.
Do	do	do	Crepicephalus nitidus n. sp.	do.
Do	do	do	Crepicephalus (L.) quadrans n. sp.	Quebec.
Do	do	do	Crepicephalus (L.) simulator n. sp.	Potsdam group.
Do	do	do	Crepicephalus (L.) unisulcatus n. sp.	do.
Do	do	do	Crepic. (Bathyrus?) angulatus n. sp.	do.
Do	do	Paradoxidae	Ptychaspis pustulosa n. sp.	do.
Do	do	do	Chariocephalus tumifrons n. sp.	do.
Do	do	do	Dikellocephalus bilobatus n. sp.	do.
Do	do	do	Dikellocephalus flabellifer n. sp.	do.
Do	do	do	Dikellocephalus gothicus n. sp.	Quebec.
Do	do	do	Dikellocephalus multicinctus n. sp.	Potsdam group.
Do	do	do	Dikellocephalus quadriceps n. sp.	Quebec.
Do	do	do	Dikellocephalus Wahsatchensis n. sp.	do.
Do	do	Asaphidae	Ogygia parabola n. sp.	Potsdam group.
Do	do	do	Ogygia producta n. sp.	do.
Do	do	do	Bathyrus Pogonipensis n. sp.	Quebec.
Do	do	Prætidae	Prætus Loganensis n. sp.	Waverly.
Do	do	do	Prætus peroccidens n. sp.	do.
Do	do	Agnostidae	Agnostus communis n. sp.	Potsdam group.
Do	do	do	Agnostus Neon n. sp.	do.
Do	do	do	Agnostus prolongus n. sp.	do.
Do	do	do	Agnostus tumidosus n. sp.	do.

EXPLANATION OF PLATE I.*

	Page.
OBOLELIA DISCOIDEA	205
Fig. 1. View of a dorsal valve, enlarged, showing the orbicular form.	
2. View of a ventral valve, showing the truncated beak. Enlarged.	
LINGULEPIS? MINUTA	206
Fig. 3. View of a cast of the shorter valve, enlarged, showing muscular scars.	
4. View of the cast of a long valve enlarged, showing the muscular scars more spreading than in the other valve.	
LINGULEPIS MÆRA	206
Fig. 5. View of a supposed ventral valve showing the extended beak.	
6. A larger valve having a shorter beak. This may be a dorsal valve.	
7. Outline showing the relative gibbosity and length of the two valves.	
LINGULEPIS ELLA	232
Fig. 8. View of a dorsal (?) valve showing the truncation of the beak. Enlarged to two diameters.	
ORTHIS POGONIPENSIS	232
Fig. 9. View of a dorsal valve of rather more than the ordinary size. Enlarged.	
10. A ventral valve of the ordinary size, and of an elongate form, showing the elevation of the beak.	
KUTORGINA MINUTISSIMA	207
Fig. 11. View of a dorsal valve, greatly enlarged, showing the peculiar striæ and the faint radiations on the surface.	
12. A ventral valve having a more elongate form.	
LEPTÆNA MELITA	208
Figs. 13-14. Views of two different individuals, showing variation in the surface-characters.	
STROPHOMENA NEMEA	233
Fig. 15. View of the specimen described, showing the general form and surface-striæ.	
PORAMBONITES OBSCURUS	234
Fig. 16. View of the exterior of a ventral valve, showing the lamellæ projecting inward from the beak.	
MACLUREA MINIMA	235
Fig. 17. View of the spire of an internal cast of a specimen. Enlarged.	
18. View of the flat side of the same individual.	
19. Profile view of the specimen, showing the depth of the shell.	

* The line drawn by the side of figures indicates the natural size.

	Page.
RAPHISTOMA ACUTA.....	235
Fig. 20. Profile of a specimen, showing the elevation of the spire.	
21 and 22. Upper and lower surfaces of the same individual.	
CYRTOLITES SINUATUS.....	237
Figs. 23-24. Lateral and profile views of a specimen, showing the features of the shell. Enlarged.	
FUSISPIRA COMPACTA.....	236
Fig. 25. View of the specimen described, which is imperfect at both ends; the outline shows the probable form of the anterior end.	
AGNOSTUS NEON.....	229
Figs. 26-27. View of the cephalic and caudal shields, greatly enlarged, showing the features as seen on the specimens.	
AGNOSTUS COMMUNIS.....	228
Fig. 28. View of the cephalic shield, greatly enlarged, showing the peculiar form of the glabella and the spine on its center.	
29. Caudal shield. Enlarged.	
AGNOSTUS PROLONGUS.....	230
Fig. 30. The cephalic shield, greatly enlarged, showing the great length and obscurely-marked glabella.	
31. View of the caudal shield associated with the above cephalic shield.	
AGNOSTUS TUMIDIOSUS.....	231
Fig. 32. View of the cephalic shield, with its peculiar and tumid glabella. Greatly enlarged.	
BATHYURUS POGONIPENSIS.....	243
Fig. 33. View of the pygidium described, showing the form and character of ribs, and the ornamenting granules on the axial rings.	
34. Profile of the same, showing the elevation of the specimen.	
<i>Alenoides</i> DIKELLOCEPHALUS WAHSATCHENSIS.....	241
Fig. 35. View of the glabella and one fixed cheek. The wider depressions on the glabella are accidental depressions on the glabellar lobes.	
<i>Same as 35</i> DIKELLOCEPHALUS ? GOTTINGENSIS.....	242
Fig. 36. View of a pygidium, showing the peculiar character of the ribs of the lateral lobes.	
<i>Alenoides</i> DIKELLOCEPHALUS QUADRICEPS.....	240
Fig. 37. Enlarged view of the glabella and fixed cheeks, showing the peculiar form of the glabella and short frontal limb.	
38. Profile of the same, showing the elevation of parts.	
39. View of the pygidium, natural size.	
40. Profile of the same, showing the great elevation.	



EXPLANATION OF PLATE II.

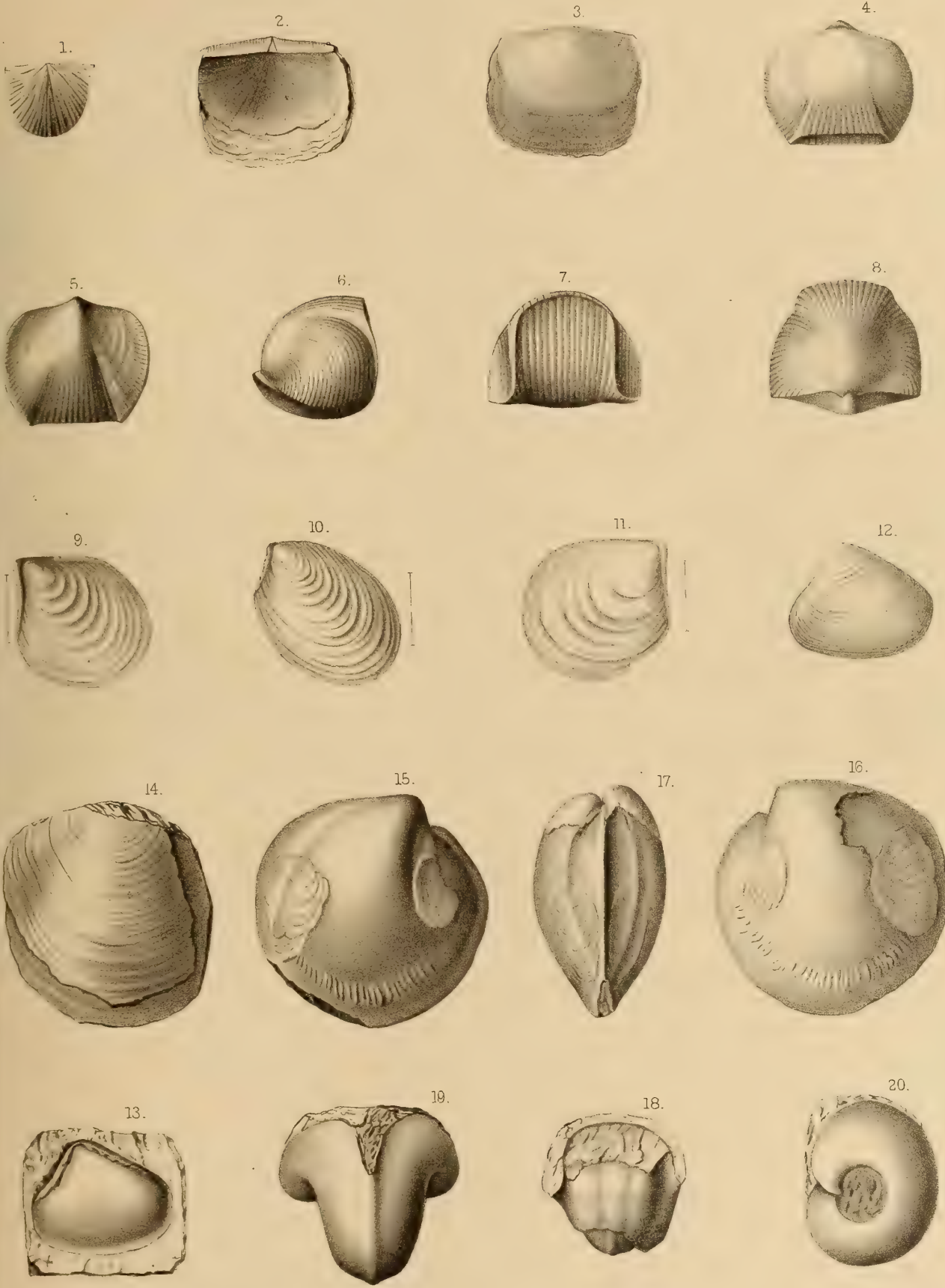
	Page.
CONOCEPHALITES SUBCORONATUS.....	237
Fig. 1. View of a glabella and fixed cheeks, showing the general characters of the species. Enlarged.	
<i>Demodanbergia</i> CREPICEPHALUS (LOGANELLUS) GRANULOSUS.....	214
Figs. 2-3. Vertical and profile views of a glabella and fixed cheeks, showing the form and surface-markings. Enlarged.	
CONOCEPHALITES (PTEROCEPHALUS) LATICEPS	221
Fig. 4. View of the central parts of the head, showing the peculiar form of glabella and extended frontal limb.	
5. A movable cheek, with a portion of the under surface of the front of the head.	
6. A part of a thoracic segment, associated with the other parts.	
7. View of an imperfect pygidium, found in the same rock.	
<i>Demodanbergia</i> CREPICEPHALUS (LOGANELLUS) NITIDUS.....	212
Fig. 8. View of the central portion of a head of the species, showing the character of these parts.	
9-10. Two pygidia, showing some variations in the details.	
CREPICEPHALUS (LOGANELLUS) QUADRANS.....	238
Fig. 11. A glabella and fixed cheeks, enlarged.	
12. View of a cheek, enlarged to twice the natural size.	
13. View of a pygidium, enlarged to three times the natural size.	
CREPICEPHALUS (LOGANELLUS) HAGUEI.....	210
Fig. 14. View of an entire individual, enlarged to twice the natural size, showing the form and characters of the animal.	
15. A single thoracic segment (third), enlarged to show more distinctly its structure.	
CREPICEPHALUS (LOGANELLUS) SIMULATOR.....	218
Fig. 16. View of the central part of a head, showing the characters of the species. The lateral limbs have been broken off.	
17. View of a movable cheek, enlarged to two diameters, showing the broad, flattened, marginal border.	
18. View of a much larger cheek, natural size (upper right-hand corner of plate).	
<i>Demodanbergia</i> CREPICEPHALUS (LOGANELLUS) ANYTUS	219
Fig. 19. View of the central parts of the head of a small individual, showing the angular glabella and strong ocular ridges.	
20. View of a movable cheek, natural size, showing the striated surface.	
21. A pygidium from the same block as the other specimens.	

CREPICEPHALUS (LOGANELLUS) UNISULCATUS.....	Page. 216
Fig. 22. View of the central part of the head, deprived of the postero-lateral limbs.	
23. View of the pygidium, associated with the above	
CREPICEPHALUS (LOGANELLUS) MACULOSUS.....	215
Fig. 24. View of the central parts of the head, showing the rounded glabella, with faintly-marked furrows, and the pustulose surface of fixed cheek, and frontal limb.	
25. A movable cheek of the same species, presenting the same surface-markings.	
26. ? View of a pygidium found associated with the above parts, but not showing pustulose markings.	
<i>Elvinia</i> PTYCHASPIS PUSTULOSA.....	223
Fig. 27. View of the glabella and fixed cheeks, the postero-lateral limbs having been removed.	
<i>Dimotolophosia</i> CREPICEPHALUS (BATHYURUS?) ANGULATUS.....	220
Fig. 28. View of the specimen described, as it appears on a gutta-percha cast, from the impression in the stone.	
DIKELLOCEPHALUS FLABELLIFER.....	227
Figs. 29-30. Vertical and profile views of the pygidium, showing the broad, undulating, lateral lobes and digitate external border.	
OGYGIA PRODUCTA.....	244
Fig. 31. View of the central parts of the head, the anterior limb broken away. The large palpebral lobes are shown, extending almost to the top of the glabella.	
32. View of a fixed cheek, associated with the glabella.	
33. View of an impression, showing the pygidium, which has probably been shortened by the contortion of the shale, and part of the thorax, while the one attached to the thorax has been obliquely lengthened.	
34. View of a separated pygidium.	
OGYGIA PARABOLA.....	245
Fig. 35. View of the pygidium, showing the elongate form and the straight cylindrical axis, with the single bulbous anterior ring.	
DIKELLOCEPHALUS (PTEROCEPHALUS) BILOBATUS.....	226
Fig. 36. View of the under side of the pygidium described, showing the form and broad recurving selvage.	
DIKELLOCEPHALUS MULTICINCTUS.....	226
Fig. 37. View of the specimen described, showing the general form, with the margins restored in outline, partly from another specimen.	
<i>Im. 3811</i> CHARIOCEPHALUS TUMIFRONS.....	221
Fig. 38. View of the glabella and fixed cheeks, showing the glabella projecting in front of the anterior limb, and the two deep glabellar furrows.	
39. Profile view of the same individual, showing the short frontal limb, with the glabella projecting beyond it.	



EXPLANATION OF PLATE III.

	Page.
STROPHODONTA CANACE	246
Fig. 1. View of a very young individual.	
2-3. Dorsal and ventral views of an older individual, presenting the features of the species.	
RHYNCHONELLA EMMONSI	247
Figs. 4-8. Dorsal, ventral, profile, front, and cardinal views of a full-grown and well-formed specimen.	
LUNULICARDIUM FRAGOSUM	249
Fig. 9. View of a short form, enlarged, showing strong undulations, and retaining the anterior flange, of large size.	
10. An elongated form, enlarged, showing a narrower anterior projection.	
11. A right valve of medium proportions, showing a strong anterior flange.	
NUCULITES TRIANGULUS	248
Fig. 12. View of a left valve, showing the surface-characters.	
13. View of the same individual after having the shell removed from all but the hinge-margin, and showing the impression of the clavicle very faintly.	
PARACYCLAS PEROCCIDENS	248
Fig. 14. View of a specimen, preserving a part of the external shell.	
15-17. Right, left, and profile views of a cast, showing the muscular imprints and pallial line.	
BELLEROPHON NELEUS	250
Fig. 18. View of a fragment, showing the callus of the inner lip and a small part preserving the external ornamentation.	
19. Front view of an internal cast, showing the form of the lip and dorsal slit.	
20. Profile view of the same individual, showing the axial cavity filled with the thickened shell-substance.	



EXPLANATION OF PLATE IV.

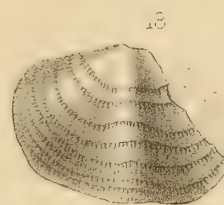
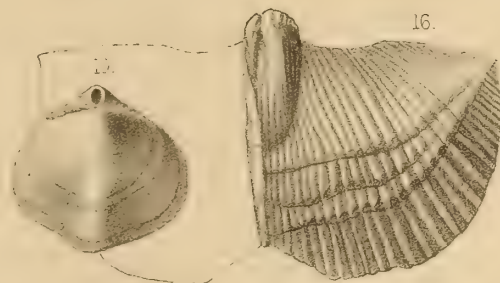
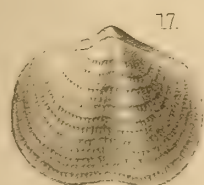
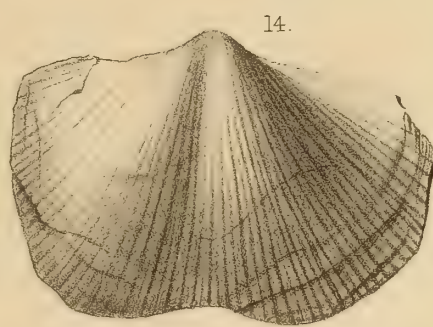
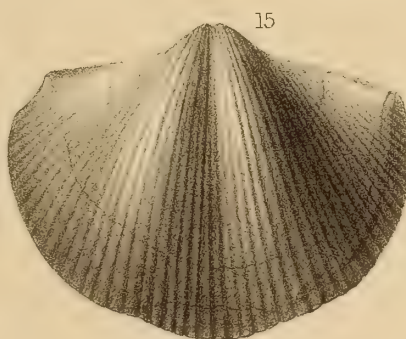
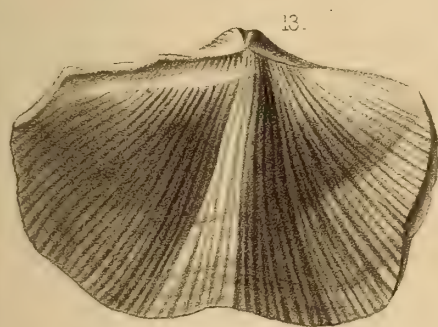
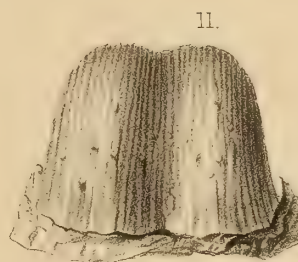
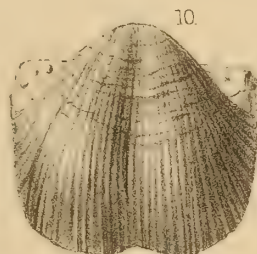
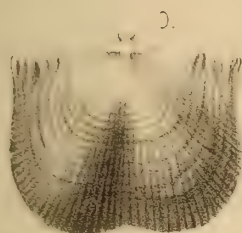
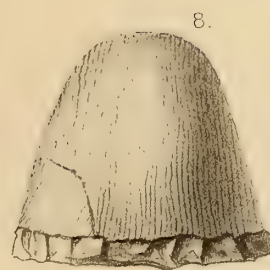
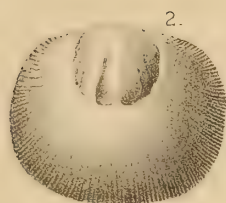
	Page.
STREPTORHYNCHUS INEQUALIS	252
Fig. 1. View of a dorsal valve, showing an unusual breadth, from Ogden Cañon.	
2. View of a narrower ventral valve, showing finer and more even striæ, from Logan Cañon.	
STREPTORHYNCHUS INFLATUS	253
Fig. 3. View of a very rotund, dorsal valve, with fine, even striæ, from Dry Cañon.	
STROPHOMENA RHOMBOLDALIS	253
Fig. 4. View of a specimen from Dry Cañon, showing fine, even wrinkles.	
SPIRIFERA CENTRONATA	254
Fig. 5. View of a large dorsal valve, showing the usual features of the species, Dry Cañon.	
6. A smaller ventral valve, from the same locality.	
SPIRIFERA ALBA-PINENSIS	255
Fig. 7. View of a ventral valve, from a siliceous layer at White Pine, Nevada, as obtained by gutta-percha cast from the matrix.	
8. Another ventral valve, from Logan Cañon, Utah.	
CHONETES LOGANENSIS	253
Fig. 9. View of the specimen described.	
ATHYRIS PLANOSULCATA?	257
Fig. 10. View of a small ventral valve from Logan Cañon.	
11. A partial cast of another ventral valve from Cottonwood Cañon, Utah.	
RHYNCHONELLA PUSTULOSA?	257
Figs. 12-13. Dorsal and front views of a specimen from Dry Cañon, Utah. Enlarged.	
14. Dorsal view of the specimen, natural size.	
ATHYRIS CLAYTONI	256
Figs. 15-17. Dorsal profile and ventral views of a specimen of the species, showing the form of shell and the perforation of the beak.	
TEREBRATULA UTAH	258
Fig. 18. View of a ventral valve, natural size.	
MICHELINA — sp.?	251
Fig. 19. View of the specimen referred to under the description.	

	Page.
EUOMPHALUS (STRAPAROLLUS) UTAHENSIS	259
Fig. 20. View of the upper surface of a large individual from Ogden Cañon, showing the obsolescence of the carina on the outer volution.	
21. View of a smaller individual from Dry Cañon, as obtained by gutta-percha impression from the matrix.	
22. A similar small specimen from Logan Cañon. The figure is an enlarged view.	
23. A view of the under side of a large specimen from near Read and Benton's mine, Utah.	
EUOMPHALUS LAXUS	260
Figs. 24-25. Profile and vertical views of a specimen from Dry Cañon, Utah.	
EUOMPHALUS (STRAPAROLLUS) OPHIRENSIS	261
Fig. 26. Lateral view of the specimen, restored partly from the shell and partly from gutta-percha impression in the matrix.	
27. View of the umbilicus. From Dry Cañon, Ophir, Utah.	
PROETUS PEROCCIDENS	262
Fig. 28. View of a glabella of the species, from Dry Cañon.	
29. View of the left movable cheek.	
30. View of a pygidium of large size, from the same locality.	
31-32. View of a smaller specimen, natural size and enlarged, showing the ornamentation of the surface, from Ogden Cañon, Utah.	
PROETUS LOGANENSIS	264
Fig. 33. View of the pygidium, enlarged to two diameters, showing the specific features of this part.	



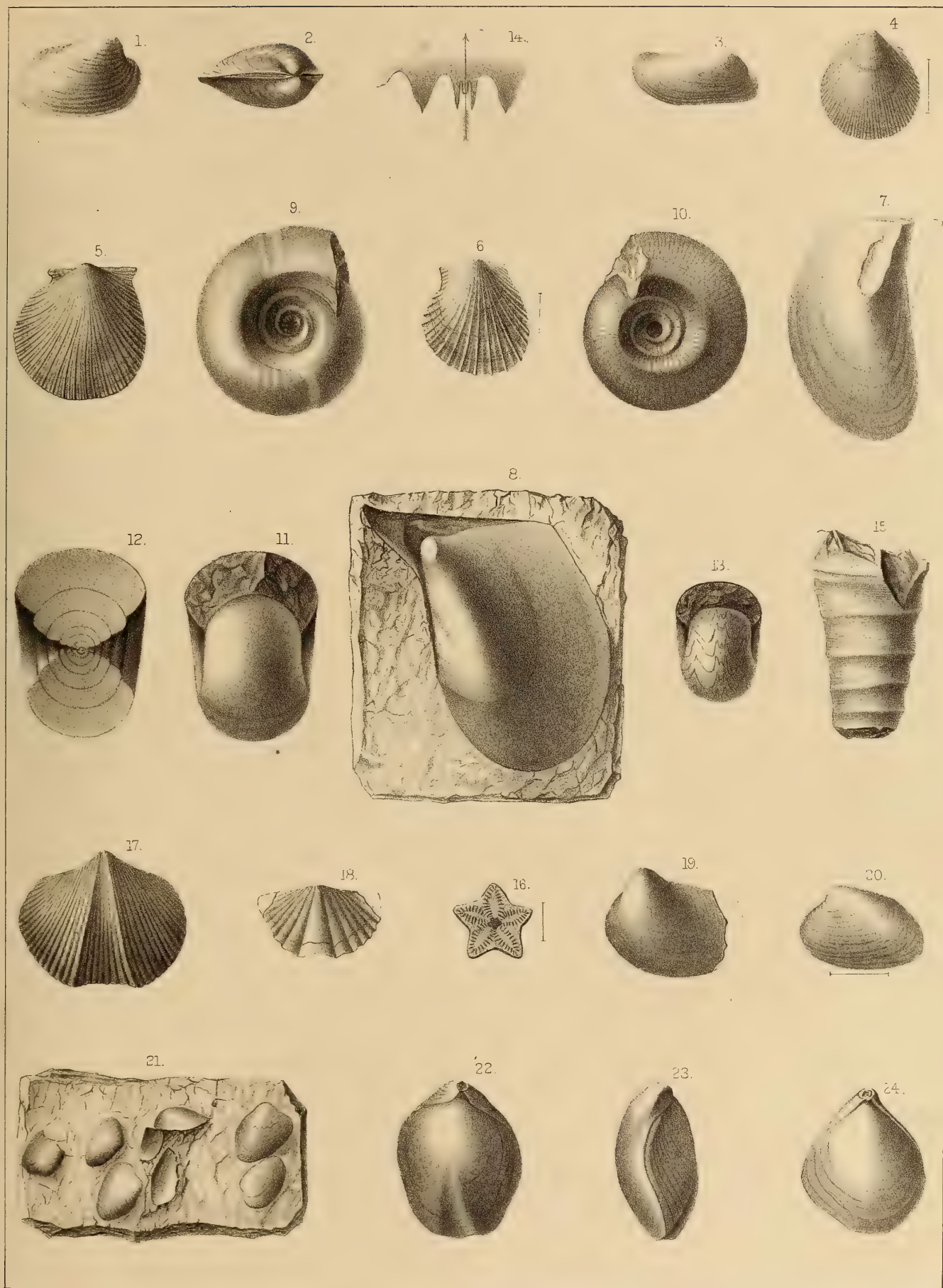
EXPLANATION OF PLATE V.

	Page.
ORTHIS RESUPINATA?	265
Fig. 1. View of a dorsal valve, slightly exfoliated, but retaining the shell in great part.	
2. A cast of a dorsal valve, showing the muscular imprint.	
PRODUCTUS ELEGANS	268
Figs. 3-4. Profile and front views of a specimen referred to this species.	
PRODUCTUS SEMIRETICULATUS	267
Figs. 5-6. Vertical and cardinal views of a specimen referred to this species, showing the form and surface character.	
PRODUCTUS LÆVICOSTUS?	266
Figs. 7-8. Vertical and front views of specimens having the form and character of the species.	
PRODUCTUS FLEMINGI var. BURLINGTONENSIS	265
Fig. 9. View of a dorsal valve, showing the cardinal process.	
10. View of a ventral valve.	
11-12. Front and profile views of a similar individual, presenting the features of those from Burlington, Iowa.	
SPIRIFERA STRIATA	269
Fig. 13. Dorsal view of a specimen somewhat crushed, but showing the specific characters of the shell.	
14. Ventral view of the same specimen.	
15. Ventral valve of another individual, showing fewer bifurcations in the plications.	
SPIRIFERA ————sp.?	271
Fig. 16. View of the fragment referred to on page —.	
SPIRIFERA SETIGERA	270
Fig. 17. View of a small specimen somewhat compressed, but preserving the surface characters and somewhat the general form.	
18. View of a larger dorsal valve, showing the form.	
ATHYRIS SUBQUADRATA?	271
Fig. 19. View of the dorsal side of a specimen referred to this species.	
20. Ventral valve of the same, showing the sinus as well as the general form of the shell.	



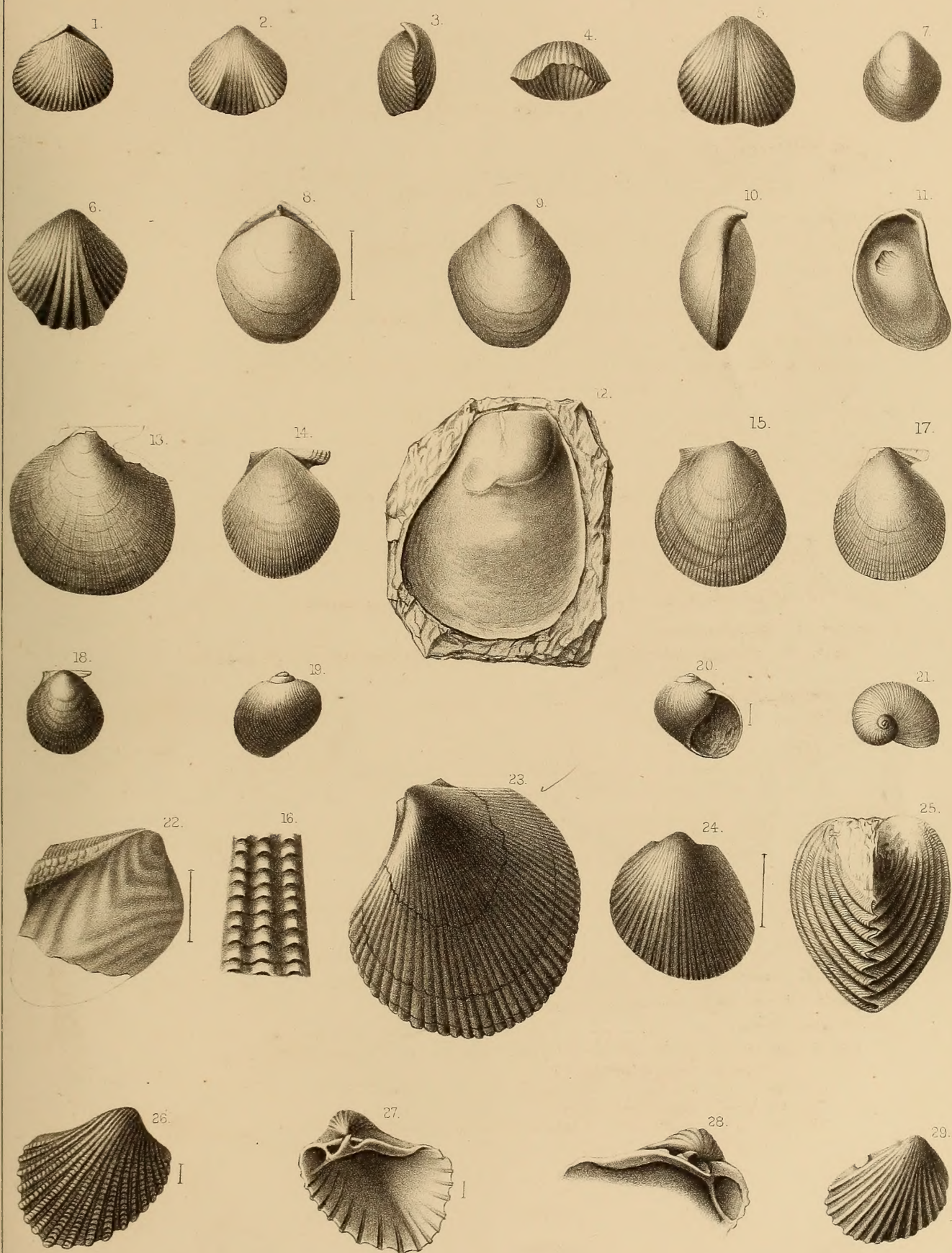
EXPLANATION OF PLATE VI.

	Page.
CARDIOMORPHA MISSOURIENSIS	277
Fig. 1. View of the right valve of a specimen of the usual size and form.	
2. Cardinal view of the same individual.	
SEDGEWICKIA ? CONCAVA	276
Fig. 3. View of a right valve, as obtained by a gutta-percha impression in the natural mold.	
AVICULOPECTEN CURTO-CARDINALIS	273
Fig. 4. View of the specimen described, enlarged to twice the natural size.	
AVICULOPECTEN WEBERENSIS	273
Fig. 5. View of a left valve, showing the strongly alternating coarser and finer striæ.	
AVICULOPECTEN PARVULUS	274
Fig. 6. View of a left valve, enlarged to three times the natural size, showing the strong elevated primary rays, with finer ones between.	
MYALINA PERMIANA	276
Fig. 7. View of a cast of a right valve, showing the usual form. The outline at the beak shows the extreme of other specimens.	
MYALINA AVICULOIDES	275
Fig. 8. View of an internal cast of a left valve, with the impression of the extended beak showing in the matrix.	
GONIATITES KINGII	279
Fig. 9. Lateral view of a specimen of medium size, showing the deep umbilicus.	
10. View of the opposite side of a similar individual, showing more distinctly the surface-markings.	
11. Profile view of the specimen fig. 9, showing the great width of the shell.	
12. Sectional view, showing the proportional size of the volutions and depth of the umbilicus.	
13. Profile view of a smaller individual, the outer volutions broken away to reveal the lines of septa.	
14. Profile of a septum from the latter, enlarged.	
CYRTOCERAS CESSATOR	278
Fig. 15. Lateral view of the specimen described, showing the curvature of the tube and the strong annulations.	
PENTACRINUS ASTERISCUS ?	280
Fig. 16. Enlarged view of a disk referred with doubt to this species. The figure is enlarged two diameters.	
SPIRIFERA (SPIRIFERINA ?) ALIA	281
Fig. 17. View of a ventral valve, showing the characters described.	
SPIRIFERINA HOMFRAYI ?	281
Fig. 18. View of an imperfect dorsal valve referred to this species.	
EDMONDIA MYRINA	283
Fig. 19. View of an imperfect left valve.	
ASTARTE ARENOSA	297
Fig. 20. View of a specimen of a left valve, enlarged.	
21. View of a fragment of rock containing several individuals, including the above. The species is placed with some doubt on this plate among the Triassic forms.	
TEREBRATULA HUMBOLDTENSIS	282
Figs. 22-23. Dorsal and profile views of a specimen, showing strong plications on the front of the valve.	
24. Dorsal valve of another individual nearly destitute of the plications.	



EXPLANATION OF PLATE VII.

	Page.
✓ RHYNCHONELLA MYRINA	284
✓ Figs. 1-4. Dorsal, ventral, profile, and front views of a characteristic specimen.	
5. Ventral valve, showing a variation of form in the sinus. 20131	
✓ RHYNCHONELLA GNATHOPHORA?	284
Fig. 6. View of the ventral valve referred with doubt to this species. 12550	
✓ TEREBRATULA AUGUSTA	285
Fig. 7. View of a ventral valve of the usual form and size.	
8-10. Dorsal, ventral, and profile views of a specimen, enlarged to two diameters. 12544	
✓ GRYPHLEA? CALCEOLA var. NEBRASCENSIS?	286
Fig. 11. Interior of the larger valve, showing the prevailing form which occurs in the localities mentioned under the description. 12540	
✓ OSTREA ENGELMANNI?	285
Fig. 12. View of an impression of the interior of the attached valve. 12534	
CAMPTONECTES BELLISTRIATUS	289
Fig. 13. View of an imperfect right valve of the size most common among those in the collection.	
AVICULOPECTEN? (EUMICROTIS) AUGUSTENSIS	288
Fig. 14. View of a right or flat valve.	
15. A left valve from the same specimen of rock.	
16. Enlargement of striae from another individual, preserving the surface.	
✓ CAMPTONECTES PERTENUISTRIATUS	291
Fig. 17. View of a right valve of the species, enlarged to twice the natural size; the posterior wing restored in outline. 12535	
✓ CAMPTONECTES EXTENUATUS	290
Fig. 18. A right valve, natural size. 12551	
NATICA? LELIA	298
Figs. 19-21. Three views of an individual of the ordinary size enlarged. The line near fig. 20 shows the natural height.	
✓ TRIGONIA QUADRANGULARIS	293
Fig. 22. View of an imperfect right valve, enlarged to twice the natural size. The outline would seem to have been considerably extended posteriorly. 12537	
✓ LIMA (PLAGIOSTOMA) OCCIDENTALIS	292
Fig. 23. View of a left valve, slightly restored at the beak and hinge, as also on the umbone. 1	
✓ EUMICROTIS CURTA?	289
Fig. 24. View of a left valve, enlarged, showing the alternate size of the radii. 20131	
SEPTOCARDIA CARDITOIDEA	296
✓ Fig. 25. View of the posterior end of the specimen described. 1	
✓ SEPTOCARDIA TYPICA	295
Fig. 26. Enlarged view of the exterior of a right valve, showing the general form and the ornamentations on the ribs. 12538	
27. View of the interior of the same valves, showing the hinge-characters as described.	
28. Enlarged hinge-line of the left valve.	
29. Cast of a large right valve, enlarged to twice the natural size, to show the posterior muscular scar.	



SMITHSONIAN INSTITUTION LIBRARIES



3 9088 00762 8274